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ANSWERS  
TO  
QUESTIONS PRESCRIBED  
BY  
DENTAL STATE BOARDS.

BY  
ROBERT B. LUDY, M. D.,  
LATE ACTING-ASSISTANT SURGEON, U. S. A., LECTURER ON PRACTICE OF MEDICINE IN  
TEMPLE COLLEGE OF PHILADELPHIA, AUTHOR OF "ANSWERS TO QUESTIONS  
PRESCRIBED BY MEDICAL STATE BOARDS," "ANSWERS TO QUESTIONS  
PRESCRIBED BY PHARMACEUTICAL STATE BOARDS," ETC.

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THIRD EDITION, REWRITTEN AND ENLARGED.

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## PREFACE TO THE THIRD EDITION.

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I HAVE carefully revised this book for the third edition, and have made numerous additions which have been rendered necessary by new questions given by different State Boards.

ROBERT B. LUDY.

( iii )

## PREFACE TO THE SECOND EDITION.

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THE endorsement of the first edition of this book by teachers and students, as shown by numerous expressions of approval, as well as by its rapid sale, is extremely gratifying to the author and seems to warrant its continuance.

In the present edition the entire text has been completely rewritten and thoroughly revised, and all new State Board Questions which appeared since the publication of the first edition have been added. It is hoped that the careful revision to which the work has been subjected has eliminated the errors which appeared in the first edition.

Many persons having an adequate knowledge of the subject in which they are tested, fail, because of their inability to interpret properly the intents and purposes of the questions to be answered by them. To aid in this, as well as to afford a convenient manual for the general preparation of Dental Students in their work, is the sole object of this book.

Having collected a large number of questions from different States, it was found that duplications occurred ranging from 30 per cent. to 80 per cent., varying according to the several subjects. Thus a comprehensive knowledge of these questions and answers will serve excellently in the preparation for future examinations before such Boards.

In order to secure a critical interpretation of the questions, and concise, yet complete, answers to the same, the author has been favored by the assistance of well-known specialists in their several lines, whose competence and experience give to the work a range and value impossible of attainment in the product of a single author.

It has been deemed advisable to unite all questions from the

different States under their respective headings, so that undue repetitions of similar questions might be avoided.

Although standard literature has necessarily been consulted, yet, in a work of this character, references would only prove cumbersome; hence they have been generally omitted.

To Drs. Boom, Buckley, Good, Northrop, Rice, Salvas and Thomas, the author makes grateful acknowledgment. The high value of their carefully prepared answers is fully appreciated by him, and will be, he is assured, by those into whose hands the work is committed.

ROBERT B. LUDY.

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## OPERATIVE DENTISTRY.

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### **What is dental caries?**

Dental caries is the disintegration of tooth tissue.

### **Give the etiology and the general preventive treatment of dental caries.**

Lactic fermentation. Thorough cleansing of the teeth by means of tooth-brushes, powder, dental floss and antiseptic washes.

### **How is dental caries classified?**

It is classified as follows: Superficial, deep-seated, simple and complicated.

### **What is superficial dental caries? Give treatment.**

It is that stage of the disease in which the caries has not penetrated the enamel. The treatment consists in its removal with disks and fine stones.

### **What is deep-seated dental caries? Give treatment.**

It is that stage of the disease which involves the zone of dentin in close proximity to the pulp-chamber.

Removal of all decay, sterilization, coating the cavity with a cavity-lining and filling.

### **Give the etiology, prognosis and treatment of inflammation of the membranes of the mouth preparatory to operations on the teeth.**

The local causes of inflammatory conditions of the membranes of the mouth are due to the presence of salivary calculus, to carious, loose, dead or diseased teeth or roots.

The prognosis is favorable. The treatment consists in the mechanical removal of the deposits on the surfaces of the teeth, and in the extraction of incurably-diseased teeth. The gums should be massaged at each sitting and the parts sprayed several times a day with the following well-diluted antiseptic solution :

Euformol .....	3j
Glycothymoline .....	℥iv
Acidi carb. ....	gttxxx

Where the inflammatory condition is the expression of constitutional disorder, derangement of the alimentary functions or catarrhal affection, general treatment is indicated.

**Give a general rule for the preparation and formation of cavities. Name the points that require special care in excavating.**

All frail overhanging walls should be removed, the cavity thoroughly excavated, sterilized, and made retentive in form. The margins should be smoothed. Care must be taken, while excavating, not to expose the pulp.

**Give the recognized stages in the preparation of a cavity for filling.**

The recognized stages are: Opening the cavity, removing the decay, shaping the cavity.

**Give the general principles governing (a) the preparation of cavities for gold fillings, (b) the insertion of gold fillings.**

(a) Opening the cavity; removal of the decay; shaping the cavity to receive and retain the filling, and the preparation of the margins.

(b) Accurate adaptation to the cavity walls; solidity and proper contour.

**How should the preparation of a cavity for a gold filling**

**differ from the preparation of a cavity for an amalgam filling?**

A cavity for gold requires direct access; the walls should be strong, and the margins smooth and beveled. Retention should be secured by well-defined pits or grooves drilled in the dentin.

A cavity for amalgam should be more or less ball-shaped; the cavity should be enlarged from within, the enamel-walls parallel, the angles removed and straight sides made concave.

**What form of burs is preferable for removing deep-seated decay? Give reason for using this form and state method of use.**

The round or oval form of burs. They are preferable because their form is similar to that of the natural outline of the cavity and, when properly used, they are not so apt to injure the subjacent dentin. They are manipulated by means of the handpiece of the engine and should revolve rapidly. The instrument should be lifted at short intervals and allowed to run free, to avoid heat from friction, and consequent pain.

**What instruments should be used to smooth or finish cavity margins?**

Chisels, broad-faced excavators, approximal trimmers, and file-cut enamel finishing-burs, Arkansas stones, etc.

**What form of bur should be used (a) for opening and following the course of sulci; (b) for forming the floor of a cavity for a gold filling?**

(a) The fissure-bur; (b) the inverted cone.

**Mention the form and advantage of excavator points for removing deep-seated decay in teeth.**

Spoon-shaped or round-bladed. Their cutting edge being oval or circular in form, the layers of decayed tissue can be removed without injuring the subjacent tissue.

**Describe the method of excavating a cavity extending**

**to the pulp, giving the form of excavator and the manner of use.**

The orifice of the cavity is enlarged and, with a round-bladed excavator, the decay is removed just below the enamel line. The remaining portion of the carious dentin is removed by placing the blade of the excavator near the base of the cavity and with draw-cuts towards the orifice each layer of decay is removed.

Round-bladed excavators of various shapes, according to the position of the cavity, are used.

**Give the general treatment and care of teeth in case of white decay.**

The carious matter should be carefully removed and the cavity sterilized, after which it should be filled with permanent gutta-percha or some other plastic. Teeth prone to this kind of decay should be subjected to frequent examination.

**Describe your method of preparing and filling approximal cavities in bicuspid and molars.**

Access to the cavity is secured by separating the teeth. If the occlusal surface is weak, it should be removed, thus converting the cavity into a compound cavity. All decalcified tooth structure is removed. Frail walls should be trimmed away and the cervical aspect of the cavity extended so as to secure a solid base. The floor of the cavity is made flat, avoiding sharp angles. The occlusal portion of the cavity should have a V shape, and the margins should be beveled and smoothed. A retaining groove or pit should be placed at the cervical termination of the cavity and slight undercuts made in the approximo-occlusal walls. The rubber dam and the matrix adjusted, a mat of crystal or fiber gold is introduced and with a foot-shaped plugger malleted to place, care being taken to carry the gold over the cervical wall. By this method the upper third of the cavity is filled. Cohesive gold is then added and used to complete the remainder of the

filling, which should be contoured the natural shape of the tooth. The gold should be well burnished and polished with strips and sandpaper disks.

In simple approximal cavities the cavity should be extended buccally, so that it can be approached from the buccal aspect. The decay and the margins should be treated as before described. With an inverted cone-drill the cavity can be made retentive in form and crystal or fiber gold inserted.

**How would you prepare and fill an approximal cavity with frail walls extending to the cutting edge of an incisor?**

The cavity should be thoroughly excavated and all frail margins of enamel should be removed. The labial margin of the cavity is brought to the cutting edge in a direct line, the cervical aspect of the cavity shaped as a flat ledge, the base at right angles with the axis of the tooth. The lingual margin should correspond to that of the labial to within a few lines of the cutting edge, where it should turn at right angles and extend across the tooth at the cutting edge to a point a little beyond the depth of the cavity. Anchorage is obtained by cutting a groove in the cervical ledge and by making an undercut in the dentin near the incisal border. The margins should be bevelled and smoothed. Cohesive gold in the form of ropes or cylinders is used. The cervical groove is filled first and the gold built down towards the incisal edge, where it is securely anchored. The mass should be kept on a line with the labial and palatal walls. The gold should be carried well over the margins and thoroughly condensed with a broad-faced plugger, using sufficient to permit of proper shaping and finishing.

**How should cervical cavities be prepared with reference to the gum margin?**

The margin should be extended well rootwards in order to include any defect in the enamel bordering it. The walls should be made smooth and free from angles.



**By what means can cavities be protected from moisture without recourse to the rubber dam?**

By the use of cottonoid or small linen napkins in conjunction with the saliva-ejector.

**What is hypersensitive dentin? Give treatment.**

It is an irritated state of the tubular contents of the dentin and prevails principally near the junction of the dentin with the enamel.

The cavity should be thoroughly dried by the use of absolute alcohol, followed by blasts of warm air; this may be followed by Robinson's remedy, caustic potassa and carbolic acid, equal parts.

**How should a cavity be treated and filled when the dentin is highly inflamed? \***

Oil of cloves should be sealed into the cavity for a few days, the decay then removed, using sharp instruments, and the cavity lined with "cavitine," after which it may be filled with cement.

**State the most efficient and satisfactory treatment of teeth that have become sensitive with a tendency to decay under plate clasps.**

The affected parts should be treated with a 25 per cent. solution of nitrate of silver.

**Describe the treatment of anterior teeth that are sensitive at the gingival border.**

An ant-acid mouth-wash should be prescribed and a solution of glycerin and tannic acid applied to the sensitive part.

**Why does the contact of fillings of different metals result in shock to the teeth?**

Because of a galvanic action taking place when the two metals are brought in contact.

\* This question is answered presuming that its author used the expression "highly inflamed dentin" as synonymous with hypersensitive dentin. Inflammation of the dentin, if there is such a pathological condition, has no bearing whatever on cavity preparation.

**Why are teeth recently filled more liable to shock from thermal changes than other teeth? Give preventive treatment.**

It is because of the immediate contact of a filling, especially a metallic filling, with the tubular structure of the dentin. It may be prevented by interposing a layer of non-conductive material.

**Describe the treatment of a tooth that is extremely sensitive to thermal changes after filling.**

A gutta-percha cap placed over the affected tooth and allowed to remain until the pulp recovers from the hyperæmia. When the severity and continuance of the pain is such as would give rise to inflammation, the filling should be removed and the cavity treated, after which it should be lined with a cavity-lining and a soft filling inserted.

**Give the cause and treatment of pits on the labial surface of teeth near the incisal edge.**

They are caused by imperfect development of the enamel. If the pits are shallow, they may be obliterated by grinding the surface with a corundum wheel, converting the surface at this point into a distinct concavity. When the pits are deeper, they are enlarged and filled.

**What is erosion? Give its cause and treatment.**

It is a chemical disintegration of tooth tissue, occurring principally upon the labial surfaces of the teeth. It is caused by the action of an acid secretion, the motion of the lips assisting in the disintegration process.

The treatment consists in prescribing an ant-acid mouth-wash. When the disintegration involves the dentin to any extent, the cavity is prepared and filled.

**Define abrasion. State causes and give method of restoration.**

Abrasion is a mechanical wearing of the crowns of the teeth. It is caused by defective occlusion and excessive wear.

Restoration is effected by the adjustment of crowns or porcelain tips, etc.

**Is the deposit of secondary dentin physiologic or pathologic?**

It is physiologic.

**What is meant by the term "eburnation"?**

The process by which the dentinal tubuli become obliterated by calcific deposits.

**How should teeth be separated for the purpose of inserting a filling?**

By means of pellets of cotton, linen tape, strips of caoutchouc or by the mechanical separator.

**What pathologic condition may result from wedging teeth?**

Disorganization and consequent death of the pulp.

**Why are the risks especially great in rapid wedging of the superior central incisors?**

Because there may occur a separation of the superior maxilla and the possibility of the incisors not returning to their normal position.

**How should teeth that have been wedged be guarded to prevent injury during the process of filling?**

They should be held firmly in place by means of orange wood, gutta-percha or phosphate of zinc.

**What is the best treatment to render a cavity aseptic?**

The removal of decay and the application of carbolic acid.

**Name the different materials used in filling teeth.**

Oxysulphate of zinc, oxychloride of zinc, oxyphosphate of zinc, oxyphosphate of copper, gutta-percha, amalgam, tin, gold and porcelain.



**What advantages has gutta-percha as a filling material?**

It is non-conductive, non-irritating, insoluble, and easily manipulated.

**In what class of cavities should gutta-percha rather than metallic fillings be used?**

In deep cavities upon the buccal surfaces of molars extending beneath the gum and not involving the masticating surface; in approximal cavities of the anterior teeth extending beneath the gum, in labial cavities, especially in teeth which are loose.

**Describe the insertion and finishing of a gutta-percha filling.**

The gutta-percha should be softened by warming it over a suitable device, after which it is introduced piece by piece, using broad-faced instruments, care being taken to adapt the gutta-percha to the margins of the cavity. The finishing consists in trimming the portions overlying the margins with a warm instrument. The instrument should be directed towards the margin and not from it.

**For what class of teeth and for what operations is phosphate of zinc valuable?**

For children's teeth and as a temporary filling in permanent teeth; in frail teeth with extensive cavities or as a lining to be covered with a metallic filling; as a retaining medium in crowns, bridge-work and porcelain inlays.

**In what class of cavities is cement unsafe?**

In cervical cavities.

**In what class of operations is the oxychloride of zinc indicated?**

In filling root-canals, capping pulps and lining cavities.

**State the advantages of amalgam over the other plastic fillings. Give reasons.**

It is more durable and possesses a wider range of appli-

cation, which is due to its insolubility and its property of withstanding the stress of mastication.

**State the conditions under which amalgam should be used for fillings. Give reasons.**

Wherever it is not exposed to view or where gold is contra-indicated. Its unsatisfactory color excludes it as a filling for the anterior teeth.

**Describe the method of preparing and inserting an amalgam filling.**

The alloy and the mercury in proper proportions are placed in a mortar and with a pestle the mass is mixed. When amalgamation is completed, it is transferred to the palm of the hand and kneaded with the fingers, after which the surplus mercury is squeezed out. It is introduced into the cavity in small pieces and pressed against the walls by tapping or burnishing. When the cavity is filled, the edges are neatly trimmed with pieces of punk. The filling should be polished at a subsequent sitting.

**How should the margins of a cavity wall be prepared for an amalgam filling?**

The margin should be so prepared that the amalgam in its adaptation is not worked to a feather edge.

**What are the physical changes in an amalgam filling after it is placed in a tooth?**

Crystallization, contraction and expansion.

**How should an amalgam filling in a compound cavity, involving the approximal and masticating surfaces of a molar, be inserted?**

A matrix should be adjusted and the amalgam introduced from the masticating surface, care being taken to have it well burnished against the matrix and the margins of the cavity.

**What advantage has amalgam over gold for filling teeth?**

The plastic nature of the amalgam renders its introduction

simpler and quicker. In cavities difficult of access it can be better adapted to the margins.

**Under what conditions are the plastic fillings preferable to gold?**

When the dentin is in a hypersensitive condition; when the cavity encroaches upon the pulp-chamber; in frail teeth and in deciduous teeth.

**In what class of cavities is tin preferable for filling?**

In temporary teeth.

**Describe method of inserting a filling of tin.**

The tooth should be isolated with the rubber dam, the tin introduced in strips or rolls, using shallow but well-defined serrated points. The tin is carried to the floor and walls of the cavity, and by the wedging process it is thoroughly adapted. As the filling approaches the marginal surface, broader points and condensers are employed. The surface should be well burnished and the filling finished by means of fine stones and disks.

**State why tin fillings arrest decay in teeth when gold fillings fail?**

Because the tin possesses antiseptic properties and, owing to its softness, is better adapted to the walls of the cavity.

**What are the characteristics that render gold such a desirable filling material?**

Pliability, softness, tenacity and agreeableness of color.

**What advantages has gold over the other materials used for fillings?**

It possesses better edge strength, it is not affected by the oral fluids, and it retains its form when properly inserted.

**How should a cavity be prepared for a gold filling?**

Frail walls should be removed, the cavity thoroughly excavated, and the margins carefully bevelled and smoothed. Anchorage is obtained by deepening the cavity at its cervical

termination and by making a shallow groove in the dentin near the incisal or occlusal border.

**What special precautions should be observed in inserting gold fillings in approximal cavities?**

They should conform to the natural shape of the tooth and should be as inconspicuous as possible.

**What is the difference between cohesive and non-cohesive gold? State the working method of each.**

Cohesive gold is a preparation of gold which possesses the property of cohesion. It is worked on the welding principle.

Non-cohesive gold does not possess the property of cohesion. It is worked on the wedging principle.

**In what respect is non-cohesive gold preferable to cohesive gold for filling teeth?**

It is more readily adapted to the walls of the cavity.

**State the advantages of cohesive gold? Give reasons.**

Owing to its cohesive property the pieces may be welded one to another; thus a filling of any size or shape can be made with it.

**Give the technic of preparing and filling with cohesive gold an approximal cavity.**

The teeth are separated until sufficient space is secured, the rubber dam adjusted and the frail walls on the approximal surface broken away with a small chisel, care being taken to preserve as much of the labial wall as possible. After the decay has been removed, using burs or excavators, the margins should be bevelled and smoothed by means of plug-finishing burs. Anchorage is obtained by grooving the dentin at the cervical termination, using small, inverted cone-burs, and by making a shallow undercut in the dentin near the incisal border. The gold is introduced in small pieces, packed into the groove at the cervical border, using shallow, serrated plugger-points. When firmly anchored, the gold is built along the floor and the palatal wall to the incisal groove.

The construction of the filling along the palatal wall should precede that of the labial aspect of the cavity, thus facilitating contouring. When the filling approaches the labial margins of the cavity, a shallow, serrated foot-plugger should be used for the remainder of the operation. The pellets of gold should be laid in regular order and carried well over the margin of the cavity, care being taken not to allow the plugger to come in contact with the enamel.

**Where would you use non-cohesive gold?**

In occlusal, buccal, lingual, labial and simple approximal cavities; also as a lining in cavities with frail walls in combination with cohesive gold. It is especially serviceable in minute cavities and in those difficult of access.

**Give the technic of preparing and filling an approximal cavity with non-cohesive gold.**

Access to the cavity is secured by separating the teeth. The cavity is excavated by means of rose-head burs and spoon-shaped excavators. It should be made oval or circular in form, the margins bevelled and smoothed, and the floor of the cavity made flat and larger than the orifice, employing for this purpose the inverted cone-shaped bur. The gold is introduced in strips or rolls, using broad, well-serrated pluggers and by means of hand-pressure. Considerable and well directed force is essential.

**Describe a method of securely anchoring a gold filling in a distal cavity with frail palatal walls in a vital superior cuspid.**

Anchorage is secured by cutting grooves in the dentin at the cervical border and by cutting an extension-arm in the palatal surface near the incisal edge.

**Describe a method of filling an occlusal cavity in a molar with shallow sulci radiating from a deep central cavity. Describe the form and condition of gold used in the operation.**

The central portion of the cavity should be filled with



semi-cohesive foil and the radiating sulci with cohesive foil, care being taken to have the filling well anchored at the extremities of the fissures.

**State the best method of applying gold to the walls of cavities in poorly calcified teeth.**

Cavities in teeth of this character should be lined with oxyphosphate. While the cement is still soft, pieces of plastic gold are pressed into it, and the surplus cement carefully removed. When the cement has become hard, the pieces of plastic gold are thoroughly condensed and the filling completed with cohesive foil.

**Give method of treating and filling a very sensitive superficial cavity with gold.**

The sensitiveness is relieved by the use of carbolic acid and blasts of warm air, after which the cavity is prepared and coated with a solution of Canada balsam and chloroform. It should then be filled with either non-cohesive or with plastic gold.

**Mention the class of cavities in which a combination of non-cohesive and cohesive gold should be used. Give reason for their use.**

A combination of non-cohesive and cohesive gold is indicated in approximal cavities with frail walls, in meso-occlusal and disto-occlusal, in ocluso-buccal and ocluso-lingual cavities.

The advantage of employing non-cohesive and cohesive gold in combination is, that the non-cohesive can be easier and better adapted to the floor and margins of the cavity, while with the cohesive gold for finishing the filling, contour and greater density is obtained.

**Give the technic of filling a cavity with a combination of cohesive and non-cohesive gold.**

Where a matrix is indicated, this device is adjusted, the tooth having been previously isolated with the rubber dam. The cavity prepared, a roll or mat of non-cohesive gold is

placed in the cavity, extending some distance beyond the cervical border. This is followed by one or more rolls, which should be malleted into place, using a foot-shaped plugger. This is continued till a third of the cavity is filled, when very cohesive gold is introduced and the filling completed, using slightly serrated plugger-points. The gold should be carried well beyond the beveled margin on the occlusal surface and thoroughly condensed with a small, finely-serrated foot-plugger.

**What causes the surface of gold fillings to blacken in some mouths?**

The action of sulphites, either taken with the food or produced chemically in the mouth; the incorporation of foreign substances with the gold during its insertion; imperfectly prepared cavities, where the gold next to the floor and walls of the cavity, if poorly condensed, will absorb more or less of the carious products. The contamination of the gold with mercury, owing to the use of an amalgam-burnisher, is also a potent factor in causing discoloration of gold fillings.

**When the walls of a cavity have softened beneath an approximal gold filling extending beneath the gums, how should the cavity be treated and filled?**

The softened tissue is thoroughly removed, extending the cavity well rootward, space having been previously secured and the gums forced away. The repair can then be made either with permanent gutta-percha or with plastic gold.

**Mention the various combination fillings and state the advantage of their use.**

Gutta-percha and cement, amalgam and cement, gold and cement, gold and amalgam, gold and tin, and the different forms of gold in combination. The advantage of combining filling materials consists in the elimination of the disadvantages of each when used separately, and in the utilizing the advantages of each when in combination.

**Designate a class of cavities in frail teeth when a combination filling of gutta-percha and zinc phosphate is indicated and give technic of operation.**

In those cavities that extend beneath the gum. The rubber dam and matrix is adjusted, the latter to prevent the gutta-percha from being forced out into the soft tissue. The cavity is excavated, sterilized and coated with Canada balsam dissolved in chloroform. The cervical margin is then filled with gutta-percha and the remainder of the cavity with cement. When sufficiently hard, it is polished and coated with melted paraffin.

**Give the technic of filling with gold and tin.**

The tin is introduced into the cavity in strips or rolls and with a short foot-plugger it is condensed against the floor and lower walls, carrying it over the cervical wall. Non-cohesive gold is then inserted in the same manner until two-thirds of the cavity is filled. The remainder of the cavity is filled with cohesive gold, which is contoured the natural shape of a tooth. Or a sheet of tin-foil may be placed between two sheets of gold and the whole folded and used as would be gold or tin alone.

**Describe a method of restoring with a combination of gold and cement badly-decayed, frail crowns of teeth.**

The rubber dam adjusted and the cavity margins bevelled, the lower third of the cavity and the walls are lined with a quick-setting cement. When the cement is hard, retaining-grooves are made and the gold introduced, and the filling finished in the usual manner.

**Mention the class of operations in which a combination of gold and amalgam is preferable to either material used separately. Give reason.**

In cavities involving the disto-occlusal surface of bicuspid and the meso-occlusal surface of molars. Amalgam alone is objectionable owing to its color. It is, however, valuable in filling the cervical borders of cavities difficult of access. Be-



cause of its plastic nature, adaptation to the margins is better and more easily secured than with gold alone.

**Give technic for inserting a combination filling of gold and amalgam.**

The matrix and rubber dam are adjusted and the cavity sterilized and dried. A quick-setting amalgam is introduced and burnished well against the floor and lower walls, filling in this way a third of the cavity. A rope of non-cohesive gold is then inserted, holding it in place with one hand, while with the other it is packed on the amalgam and against the walls, using an oval-shaped foot-plugger. Several layers of this gold are used; the filling is finished with cohesive gold.

**Describe in detail the method of restoring with a combination of amalgam and cement, frail broken crowns.**

The edges of the cavity should be carefully trimmed and the rubber dam adjusted. Amalgam sufficient to fill one-third of the cavity is prepared. Before inserting it, two-thirds of the cavity are filled with soft cement, into which the amalgam is placed, forcing the cement into every portion of the cavity. That which oozes out is carefully removed from the margins and the filling finished with amalgam.

**State in what class of cavities and under what conditions a matrix is essential.**

In distal compound cavities of bicuspid and molars. It is especially essential when plastics are employed.

**State the advantages and disadvantages of a matrix.**

It converts compound cavities into simple cavities and facilitates contouring. When employed in mesial cavities, it obstructs the light and makes it difficult to adapt the gold to the cavity margins.

**What are the comparative merits of hand and mallet pressure?**

Hand pressure permits of greater distribution of force,

which is essential in the condensation of the non-cohesive and the plastic golds. It produces less shock to the tooth and is less liable to injure the walls of the cavity when brought in contact with them.

Mallet pressure permits of working with greater rapidity. It possesses marked penetrative force and gives greater density to filling.

**Give technic of the operation of restoring teeth by the use of porcelain inlays.**

The cavity should be prepared so as to be free from undercuts, the edges should be smooth and square. Where high-fusing porcelain is to be employed, the matrix must be made of rolled platinum one one-thousandth of an inch in thickness. It should be well annealed and placed over the cavity into which it is forced with a ball-burnisher or with a pellet of wet cotton, care being taken to have the margins smooth and sharply defined. The matrix is then removed and heated to redness in order to destroy all organic matter. The body should be thoroughly mixed with distilled water, dried with blotting-paper and placed in the matrix with a fine-pointed spatula. Tapping the pliers which hold the platinum will settle the body to the bottom. It is then dried by holding it a few seconds at the opening of the muffle, into which it is gradually introduced and baked until a gloss appears. When cool, it is placed in the cavity. The edges are now reburnished and sufficient body is added to fill the matrix completely and to give the desired shape to the filling. It is dried and baked as before. The platinum should now be stripped off and the under surface grooved with fine disks. The cavity should be thoroughly dried and undercuts made, after which it is partially filled with cement and the inlay pressed home.

**How may excessive contraction be avoided in making large contour porcelain fillings?**

By imbedding one or two small chips of a porcelain tooth in the body mixed for the first baking.

**What class of cavities and what condition of the teeth are most favorable for the insertion of porcelain inlays?**

Labial, buccal and simple approximal cavities. Frail and sensitive teeth.

**What are the advantages of the porcelain inlay as a filling material?**

It resists the action of the oral fluids, is non-conductive and possesses harmony of color and strength to withstand mastication.

**Describe a method of making gold inlays.**

An impression of the cavity should be taken in modeling compound and run in oxyphosphate of zinc. From this is made a matrix of No. 36-gauge pure gold, which is also burnished to fit the cavity in the tooth. It is then removed (the under surface should be coated with whiting to prevent the solder from flowing over the edge) and 22-carat solder flowed into the matrix, using enough to fill it partially. The contour or cusp, as the case may be, is obtained by placing in the matrix mats of crystal gold, and filling the interstices with 22-carat solder. The filling is then inserted in the same manner as porcelain inlay.

**In what class of cavities and in what condition of teeth is the gold inlay indicated?**

In frail teeth and in compound approximal cavities of bicuspids and molars.

**When are artificial crowns and bridges indicated and when not?**

A crown is indicated when filling materials fail to properly restore a tooth to usefulness. It is counter-indicated when the root is diseased.

When one or more teeth are to be inserted and proper anchorage can be secured, a bridge is indicated. When there are no desirable abutments and when gum tissue is to be restored, a bridge is counter-indicated.

**(a) What is thermal test, (b) how is it conducted, (c) for what purposes is it useful?**

(a) Thermal test is the application of water to the teeth 20 to 60 degrees F. below the blood-heat, and 20 to 50 degrees F. above the blood-temperature.

(b) The rubber dam is adjusted; cavities, if present, should be closed with a pellet of wet cotton. A stream of water is injected with a syringe.

(c) To diagnose the condition of the pulp, also the degree of sensitiveness of the dentin.

**What is odontalgia? Of what is it the symptom?**

Odontalgia is pain in the tooth; it is the symptom of some functional or structural disturbance of the pulp.

**What methods should be employed to distinguish and locate odontalgia from idiopathic neuralgia?**

The thermal test, also tapping of the tooth.

**What are the characteristic symptoms of neuralgia arising from a crowded denture?**

Reflex pain generally felt in the head and face and extending down the neck.

**What is pulpitis? Give etiology and symptom.**

Inflammation of the pulp. It is caused by the invasion of bacteria, the close proximity of a filling, by a blow, or the continued irritation resulting from thermal changes. The symptom is severe pain, increased by the application of heat.

**Give treatment in case of pulpitis.**

In cases where the inflammation is acute in character, a pledget of cotton saturated with oil of cloves or eucalypti applied to the pulp and sealed in the cavity for a few days. The cavity is then carefully excavated, the pulp protected and the filling inserted.

In cases of chronic pulpitis the inflammation should first be allayed by the application of oil of cloves, after which the pulp should be devitalized and extirpated.

**How should a congested pulp be treated?**

If the congestion is acute, the pain may be allayed by an application of a sedative, the pulp capped and a temporary filling inserted. If the hyperæmia is chronic, the congestion is relieved, after which the pulp is devitalized and extirpated.

**How should a freshly-exposed pulp be treated?**

The pulp and the adjacent tissues are thoroughly sterilized and the pulp capped.

**Give treatment of inflammation of the pulp in a superior central incisor that has a gold filling in good condition in the approximal surface.**

The pulp-chamber is opened from the distal surface (the basilar pit), the inflammation subdued by applying formalin, 3 per cent., after which the pulp is devitalized and extirpated.

**Describe the method of treatment in painful pulp exposure.**

The inflammation is subdued by applications of eugenol and the pulp protected from external influences by dressings of cotton saturated with sandarac, after which the pulp is devitalized and removed.

**When is protection to the dental pulp from thermal changes indicated and how is it accomplished?**

When a cavity is deep-seated or when a tooth is excessively sensitive to heat or cold.

It is protected by means of a cavity-lining. In a tooth not affected by caries, the sensitive part—if in an inconspicuous place—is coated with a solution of nitrate of silver; in the anterior teeth with a solution of tannic acid and glycerin.

**How may irritation of the dental pulp be determined and located when there is no pulp exposure?**

By means of the thermal test and percussion.

**When the pulp of a tooth has sloughed, having dis-**



**charged through a cavity, how should it be treated and filled?**

The canal should be sterilized with a 4-per-cent. solution of formalin followed by sodium dioxid. It is then thoroughly scraped and washed with hot water, after which it is dried, using alcohol and warm air. A dressing of eugenol is sealed with temporary gutta-percha and removed once a week until all evidence of decomposition has disappeared, when the canal and cavity may be filled permanently.

**How may an inflamed pulp be diagnosed and located when no cavity exists?**

By isolating the tooth and the application of heat and percussion.

**When should a pulp be capped, and why?**

When it has been exposed, either accidentally or when the exposure is of recent origin, the result of caries, and then only in such cases where there has been no congestion and no evidence of inflammation. The object is to protect the pulp from pressure and to assist it in overcoming any bacterial invasion with which it may have been affected.

**What symptoms would counter-indicate the capping of a pulp?**

Local pain, reflected pain, soreness to touch and susceptibility to heat.

**Describe minutely your treatment and manner of capping a pulp.**

The rubber dam adjusted, the cavity is thoroughly cleansed, sterilized and dried. A dressing, composed of carbolic acid and oil of cloves, equal parts, combined with zinc oxide to make a paste, is placed over the pulp, care being taken not to produce any pressure. This is protected with a concave disk of pure tin. A filling, temporary in character, may then be inserted.

**What classes of operations tend to induce a pathological condition of the pulp and membranes of the teeth?**

The correction of irregularities, excessive grinding of teeth, rapid wedging, the preparation of cavities, and the placing of fillings in too close proximity to the pulp.

**What are pulp stones? Give treatment.**

Pulp stones are a formation of calcified matter within the pulp cavity. The treatment is devitalization and removal of the pulp.

**Give diagnosis of irritation from pulp stones.**

The pain is dull and reflected and the paroxysms are frequent. There is sensibility to cold and seldom pain on percussion. When the teeth are sound, the affected one can be determined by the thermal test.

**What causes the deposit over an exposed pulp?**

Irritation of the dentinal fibres which increases the functional activity of the pulp.

**When should a pulp be devitalized?**

When it has become the seat of irritation from pulp nodules, chronic inflammation or morbidity. In cases of traumatic exposure, as in fractured teeth, and for the purpose of inserting certain forms of crowns.

**What are the risks attending the devitalization of pulps by arsenic?**

The destructive action on the adjoining tissues in case of its escape from the cavity.

**How should a pulp be devitalized by arsenic when decay exists below the soft tissues?**

The soft tissues are pressed out and protected with temporary stopping, after which arsenic may be applied.

**Give a safe and reliable way of applying arsenic for the devitalization of pulps.**

The rubber dam should be adjusted, the arsenic applied

and the cavity filled with oxychlorid of zinc. When the rubber dam is removed, the surrounding tissues should be bathed with a solution of dialized iron.

**What are the symptoms of arsenic poisoning of the gum tissue?**

The gum is of a bluish-white color, there is pain about the affected parts, and the teeth are sore and loose in their sockets.

**Give a method of removing pulps other than by devitalization.**

The pulp is carefully exposed, a saturated solution of cocaine in chloroform applied, and the cavity filled with a piece of unvulcanized caoutchouc on which pressure is brought to bear with a large ball burnisher. In this manner the pulp can be anesthetized in a few minutes, after which it is removed in the usual way.

**Describe the diagnostic signs of a dead pulp in a tooth when there is no pulp exposure.**

There is no response to the application of excessive cold, especially that produced by an ethyl chlorid spray. There is also a marked opacity of the tooth.

**How would you diagnose a diseased pulp in an apparently sound tooth?**

Diseased pulps may be diagnosed by their altered response to the thermal test and by tapping.

**How should a pulp canal be prepared for filling?**

It should be well opened and thoroughly cleansed by means of instrumentation and sterilization.

**State a method of filling pulp canals.**

Oxychlorid of zinc introduced upon strands of fiber asbestos; also chloro-percha introduced in the canal in which gutta-percha points are inserted.



**Describe a method of filling a root canal having a large apical foramen.**

The canal is thoroughly dried, the walls are moistened with eucalyptus, a gutta-percha cone, approximating in size the foramen, is inserted and forced up until the patient flinches, after which the canal is filled in the usual manner.

**How should crooked buccal root canals be treated and filled?**

The canal should be opened by means of sulphuric acid and the Donaldson's canal-cleanser, after which they are syringed with a solution of chlorid of zinc, which is followed by blasts of warm air. The canal should be filled with chloro-percha containing hydronaphtol.

**Give the method of removing a pulp and filling the root canals in inferior molars with approximal cavities in distal surfaces.**

The cavity must be sufficiently enlarged to permit of direct access to the pulp-chamber. The pulp is removed with a barbed broach, the canals are well opened, sterilized and filled with gutta-percha points.

**Under what condition is immediate root-canal filling advisable.**

When the pulp has been extirpated *en masse*.

**What is mummification of the dental pulp? State under what condition such treatment would be advisable.**

It is the method by which the pulp is deprived of its moisture, or so changed as to be impervious to putrefactive agents.

When the canals cannot be thoroughly cleansed and filled, this treatment is indicated.

**Describe a method of treating a perforated root where the gum has grown through the opening, filling the pulp chamber and resembling a fungoid pulp.**

The growth should be removed by means of a finely-pointed

lance, the tissue having been previously anesthetized with ethyl chlorid. The bleeding can be controlled by means of applications of tannin. Pellets of cotton, saturated with tincture of iodine, are packed against the tissue, and the canal and cavity filled with cotton dipped in sandarac varnish. This treatment is continued each day, or until the margins of the perforation are plainly seen. The canal should then be cleansed, sterilized, dried and filled with gutta-percha to about half its depth. A piece of platinum foil, No. 60, is then cut, slightly larger than the perforation, dipped in chloro-percha and placed against the opening. The remainder of the canal is filled with zinc phosphate.

**Give the treatment of inflamed periosteum resulting from the filling of pulp canals.**

It consists in the application of counter-irritants to the gums.

**Why do pulpless teeth lose their natural hue?**

It is because of the death of the protoplasmic processes contained in the dentinal tubules—the result of the removal of the main central organ.

**What causes the pink color sometimes found in teeth?**

It is the absorption of the hemoglobin by the tubular structure of the dentin, resulting from the breaking down of the corpuscular elements in the blood.

**What causes pulpless teeth to blacken?**

The absorption of the products of decomposition of the proteid elements of the pulp by the dentinal tubules; also the effect of metallic salts which are used in dental therapeutic treatment.

**Give a method for bleaching teeth.**

Remove all extraneous matter, adjust the rubber dam and fill the upper third of the root with gutta-percha. Pyrozone (25 per cent. etherial solution of hydrogen dioxid) is applied to the remaining unfilled portion of the canal. It should be

introduced on small pledgets of cotton and inserted by means of a platinum canal-plugger. After each application the solution is evaporated by blasts of warm air from a hot-air syringe. This is continued until the desired effect is produced.

**What diseases may arise from a putrescent pulp?**

Pericementitis and alveolar abscess.

**What causes pericementitis?**

Pericementitis is the result of inflammation of the pulp, irritation from a dead or decomposed pulp, the use of arsenious acid, salivary calculus, mercurial poisoning, malocclusion, excess of filling material, and caries extending beyond the margins of the gum.

**What characteristic pain results from a pathological condition of the peridental membrane?**

Dull continued pain, elongation of the affected tooth, with painful response to pressure.

**What are the distinguishing symptoms of pericemental and pulp pain?**

Pericemental pain is increased by pressure upon the affected tooth. Pulp pain responds to thermal variations.

**Give treatment of pericementitis.**

The pulp-chamber is opened to give vent to the incased gases, after which the canal is thoroughly reamed, cleansed and sterilized. A dressing of cotton saturated with camphophénique is sealed in the canal and changed from time to time until all odor and pain has disappeared, when the tooth may be filled. When the tooth is too sore to permit of thorough instrumentation, counter-irritants are applied and quinine and ammonol administered in small doses.

**Describe the treatment of pericementitis when the root canal is permanently filled.**

The treatment consists in the application of counter-

irritants to the gum and in the administration of sedatives and a saline cathartic. Should this fail to give relief, then the gum is deeply scarified, the filling removed from the canal and the canal treated antiseptically.

**Give the diagnosis of pericemental abscess. State the treatment employed and medicaments used.**

The tooth is loose, elongated and sore, the gum swollen and inflamed. There is a feeling of relief when pressure is applied. The treatment consists in applying counter-irritants to the gum and in gaining access to the abscess tract along the line of the root, in which is injected a 3 per cent. solution of pyrozone followed by a 10 per cent. solution of chlorid of zinc.

**How should alveolar dental abscess be treated?**

The treatment of alveolar abscess consists in gaining free access to the diseased area, in opening, cleansing and sterilizing the canals. The abscess tract is then washed with a 3 per cent. solution of pyrozone. If the abscess is without a fistula, an effort is made to evacuate the pus through the canal. Should this fail, an entrance must be gained through the gums, which is accomplished with a pointed bistoury or engine-drill. If the abscess has a fistula, it is sometimes necessary to enlarge it in order to allow a free escape of the pus. The entire tract is then washed with a 3 per cent. solution of pyrozone and the canal treated with cotton dressings of campho-phénique or Black's 1, 2, 3 mixture. This is repeated at intervals of two or three days until the abscess cavity is healed, when the canals and the cavity can be filled. In chronic cases, where the disease fails to respond to the medicinal treatment, amputation of the root is indicated.

**What is a blind abscess?**

It is a chronic abscess without a fistula.

**What is the treatment of an alveolar abscess without**

**fistula when the roots have been properly treated and filled?**

An opening is made through the gum and the alveolar process, and the pus evacuated. The abscess-tract is then washed out with a solution of 3 per cent. pyrozone followed by an injection of a 10 per cent. solution of chlorid of zinc.

**What is root amputation? Describe the operation.**

It is the excision of the apex of the root. The operation consists, first, in rendering the parts aseptic. A vertical incision is then made, exposing the process. With a large rose-head bur, sufficient of the process is removed to permit of working on the root. The opening thus made is packed with cotton saturated with phénol sodique until the bleeding ceases. The portion of the root to be removed is then exposed and with a small, rapidly-revolving fissure-bur, amputated. The excised portion is taken out by means of a small excavator. The edges of the remaining root are smoothed with a sharp scaler. The cavity is syringed with mercuric chlorid, 1-1000, and packed with iodoform gauze. This dressing is renewed after a few days. The patient is instructed to use frequent washes of phénol sodique.

**Describe the process of replanting teeth and state precautions necessary.**

The mouth is thoroughly sterilized and the tooth extracted. It is immediately placed in a warm solution of mercuric chlorid, 1 to 1,000. The socket from which the tooth has been removed is syringed with pyrozone and packed with cotton saturated with campho-phénique. The tooth is dried, and if the root has been denuded of the pericementum, that portion is cut away and the end smoothed. The canal is opened, sterilized and filled with gutta-percha; the tooth is then returned to the antiseptic solution. The cotton is removed from the socket, which is again washed with pyrozone and the tooth then returned to position. It is attached to



the adjoining teeth with ligatures and held firm for a week or ten days.

**Describe the operation of implanting and the precautions necessary.**

The operation of implanting consists in making an incision through the gum tissue. By means of the trephine or a reamer, a socket is drilled into the maxillary bone. During the process of preparing the socket, the tooth to be implanted is frequently inserted until the proper adjustment has been secured. When this is obtained, the tooth and the contiguous parts should be placed in aseptic condition. The tooth is then inserted and held firm by means of ligatures until nature has deposited a calcific matrix around it.

The precautions necessary are thorough asepsis and the avoidance of dangerous anesthetics. Care must be taken in preparing the sockets for the superior central incisors because of the proximity of the anterior palatal nerve and vein. With the lateral incisors care must be taken to preserve the labial plate of the alveolus. The bicuspid and molar region present the danger of perforation of the floor of the maxillary sinus.

In the lower jaw the precaution necessary is to avoid the vessels passing through the mental foramen.

**Give diagnosis of exostosis. State the cause and treatment.**

There is more or less pain in and about the region of the deposit. Not infrequently the pain is reflected to parts quite remote from the seat of the trouble. In many cases a pronounced swelling can be felt on the alveolus over the affected tooth.

The cause of exostosis is irritation of the peridental membrane. Treatment: In the early stages the application of iodine may retard its progress. When the disease is well advanced, extraction is indicated.

**Give method of extracting a tooth with the root so en-**



**larged by exostosis that its removal through the socket must result in fracture of the jaw.**

A portion of the alveolar wall over the affected organ is removed. This will permit of the tooth being lifted out in the usual manner.

**When is the extraction of teeth indicated?**

When teeth are the seat of an incurable disease, or when they are associated with diseases of the maxillary sinus or the nasal chamber; to prevent or correct irregularities, in case of excessive looseness of the teeth through loss of the surrounding tissues.

When teeth are retarded in their eruption, thus causing considerable pain. In the preparation of the mouth for an artificial denture it is sometimes expedient to remove one or two remaining teeth.

**Mention some of the conditions which necessitate special precautions in extracting teeth.**

Crowded teeth, where the forceps cannot be properly adjusted; crowns with frail walls, and impacted teeth.

**Give method of extracting the roots of an inferior third molar when the crown is broken off and the gums are swollen.**

An incision is made in the gum buccally and lingually so as to permit getting a firm hold of the root with the forceps. Then by an upward and backward movement the root is removed.

**Describe the operation of extracting incisors, cuspids, bicuspid and molars.**

All teeth with single and rounded roots are removed by a rotary movement. Those with flattened single roots by an in-and-out movement. The superior molars are removed by an in-and-out movement; the inferior molars by an out-and-in movement.

**At what age is it best to extract the first permanent molar? Give reason.**

When this molar cannot be permanently preserved, it should be retained up to a period between the tenth and twelfth year, or until the second molar is about to erupt. If lost before that period, it will cause an irregularity. If later, the space it has occupied is never completely closed and the adjacent teeth will incline towards the vacant space, thus an impairment of the occlusion results.

**What accidents are liable to happen during the extraction of teeth?**

The breaking of the tooth or root, the fracture and removal of the alveolar plate, the breaking of the tuberosity, the fracture of the lower maxilla and excessive hemorrhage.

**Describe the treatment of excessive hemorrhage following tooth extraction.**

The administration of ergot in small doses; packing a rope of cotton saturated with a solution of tannic acid, adrenal or hydrogen dioxid (25 per cent.), into the alveolus, and a compress made of modeling compound.

**What anatomic changes are produced by the loss of the teeth?**

Resorption of the alveolar walls, which results in altered facial expression.

**When is the extraction of deciduous teeth indicated?**

When they are badly diseased, affecting the general health; when the permanent teeth are about to erupt.

**What (if any) possible evils may arise from premature extraction of temporary teeth?**

Impaction and irregularity of the permanent teeth.

**In doubtful cases how would you distinguish a temporary from a permanent tooth?**

By its size, which is relatively smaller; by the color, which

is whiter, and by a marked depression on the neck at the union of the enamel and the cementum.

**Under what conditions in deciduous dentition is lancing of the gums indicated? Explain.**

Fretfulness, inability to sleep and general derangement, and when the gum tissue is inflamed.

The operation relieves the resistance which the gum offers to the erupting teeth and allows them free access.

**Describe a method of treating decay in deciduous teeth.**

The decay should be removed, care being taken not to encroach upon the pulp, the cavity sterilized or coated with a solution of nitrate of silver and filled with one of the plastics.

**Give method of treating and filling approximal cavities in permanent teeth of children when these teeth are deficient in lime salts.**

The decay should be thoroughly removed, the cavity sterilized and filled with gutta-percha.

**How should an abscessed deciduous tooth be treated?**

The pulp-chamber should be opened and the pus evacuated either through the canals or by means of a bistoury passed into the swelling. The canals should then be sterilized with pyrozone followed by an application of oil of cloves. Several treatments are necessary to obtain thorough asepsis, after which the canals are filled with strands of cotton saturated with oil of cassia, the cavity with gutta-percha.

**Give etiology and treatment of green stain on children's teeth; mention the medicaments used.**

It is a growth of fungi (*leptothrix*) upon the surface of the teeth. It is removed with pulverized pumice and tincture of iodine applied on a point of orange wood, after which the teeth should be thoroughly polished.

**What injury may result from green stain on children's teeth?**

Erosion of the enamel, in consequence of which decay takes place.

**What are the best materials for filling deciduous teeth?**

Gutta-percha, oxyphosphate cement and amalgam.

**Give the treatment in case of pulp exposure attended with pain in a deciduous tooth.**

The treatment consists in allaying the pain with applications of carbolic acid, after which the pulp should be devitalized and removed.

**Give the treatment of exposed pulp in deciduous teeth of a child six years of age. Give reasons.**

The treatment indicated is devitalization and removal of the pulp. This is more satisfactory than conservative treatment, because of the difficulty of properly capping an exposed pulp in a deciduous tooth.

**How should the pulps of deciduous teeth be devitalized?**

By means of "devitalizing fiber," which should be sealed in the cavity and allowed to remain for twenty-four hours. Carbolic acid, iodine and aqua ammonia are also effective.

**How should the pulp canals of deciduous teeth be filled?**

With a paste of iodoform and glycerol.

**Give the treatment of a child ten years old whose central incisors are broken, so that the pulps are exposed.**

Powdered cocaine crystals moistened with distilled water are applied to the exposed surface of the pulp; over this is placed a small piece of punk to which pressure is applied and continued until the pulp is anesthetized. It is then removed, the canals are filled with gutta-percha and the external opening with gold. At the fifteenth year the teeth may be restored to their normal shape by adjusting porcelain tips.

**How should a first permanent molar with inflamed pulp be treated in a child seven years of age?**

When the pulp in a first permanent molar has become inflamed, the inflammation should be allayed by applications of eugenol and the pulp capped. If pain has existed periodically for longer than a week's time, the pulp should be either devitalized or mummified.

It is, however, highly questionable that at seven years of age the first permanent molar would have an inflamed pulp.

**Mention treatment of defective rough condition of sulci in children's teeth before softening occurs.**

The fissures should be treated by applications of a 25 per cent. solution of nitrate of silver.

**Give directions for the general care of the mouth and teeth of children.**

Directions should be given for the proper use of the brush, dental floss and a suitable tooth-powder. The teeth should be cleansed after each meal and frequent examinations advised, at which time the surfaces of the teeth should be thoroughly polished.

**What is dental orthopedia?**

It is the correction of dento-facial deformities by means of regulating appliances.

**What are the principal causes of irregularities in teeth?**

The causes are hereditary, constitutional, and acquired.

**Mention some of the causes of acquired irregularities.**

The premature loss of deciduous teeth, the too long retention of deciduous teeth, early loss of permanent teeth, thumb-sucking, and delayed eruption of permanent teeth.

**What accidents may happen during the correction of dental irregularities?**

Death of the pulp, rupture of the pericementum, injury to the enamel, and enlargement of the alveoli.



**Name two typical cases of acquired irregularity. Describe your treatment.**

1. The permanent cuspids standing outside of the arch.
2. Excessive protrusion of the superior incisor teeth.

Treatment for case 1: If space is needed and expansion of the arch is contra-indicated, the first bicuspid must be extracted. This is frequently sufficient to allow the cuspids to assume their natural position. When an appliance is indicated, the cuspids and molar teeth are banded and small hooks soldered to each on the labial and palatine surface. To these hooks rubber bands or linen ligatures are attached and the teeth drawn in position.

Treatment for case 2: If space is needed, the first bicuspid is extracted and the cuspids drawn back by means of jackscrews. The anterior teeth are drawn back by means of rubber bands attached to hooks soldered to molar bands. Notched bands on the central incisors will keep the rubber from sliding towards the gum. When the teeth are moved to their position, they should be held by means of a retainer, consisting of a labial bow attached to anchor-bands placed on the second bicuspid.

**How can the upper arch be expanded?**

By means of the coffin-split plate.

**How would you locate an unerupted tooth?**

By means of the X-Rays a radiograph of the parts can be taken; this will show the exact position of the tooth.

**How may an unerupted cuspid tooth be drawn into position?**

The crown of the tooth is exposed by making an incision through the gum. A small hole is drilled in the tooth in which a screw is secured. To this is attached a rubber band, fastened to a bar extending from the lateral incisor to the bicuspid. By this means the tooth can be drawn to its proper position.



**State a method of reducing an extruding lateral incisor.**

A band is adjusted to the central incisor and one to the cuspid. To these bands bars are soldered, one on the labial and one on the palatal surface. A rubber band is stretched from the palatal to the lingual bar and over the cutting edge of the extruded tooth. By this means it can be forced in position.

**State the importance of removing deposits from the crowns and necks of teeth.**

Deposits on the crowns and necks of the teeth will cause, if allowed to remain, inflammatory disturbance of the gums and the contiguous tissues.

**Describe methods of removing these deposits and give the subsequent treatment.**

The deposits are removed by means of scalers of various sizes and forms. The instrument should be inserted beneath the free margin of the gum and drawn towards the occlusal aspect. The surfaces thus scraped and the gingival borders of the gums are treated with a solution of hydronaphtol and alcohol. The teeth should then be thoroughly polished.

**Differentiate salivary calculus and sanguinary calculus.**

Salivary calculus is deposited from the saliva upon the exposed surfaces of the teeth.

Sanguinary calculus is a deposit upon the roots of the teeth. It is precipitated from the liquor sanguinis of the blood.

**Differentiate pyorrhea alveolaris and salivary calculus. Give the cause, prognosis and treatment of each.**

Pyorrhea alveolaris is a flowing of pus from the alveoli, attended with more or less destruction of the alveolar process and the adjacent tissues. The exciting causes are a subgingival deposit of calculi. The prognosis is favorable, except when the disease has become chronic and is in part due to constitutional tendencies.

The treatment consists in a thorough scaling of the teeth and syringing with a 3 per cent. solution of pyrozone. The pockets are then saturated with trichloroacetic acid, after which they are treated with tincture of iodine followed with a solution of hydronaphtol and alcohol. The teeth, if loose, should be ligatured and mal-occlusion corrected.

Salivary calculus is a deposit from the saliva upon the exposed surfaces of the teeth. The treatment consists in its removal by means of scalers and in polishing of the surfaces of the teeth.

**Pyorrhea alveolaris is sometimes the local manifestation of which nutritional disorders?**

Gout, diabetes, chronic rheumatism, scurvy, and anæmia.

**In the treatment of pyorrhea alveolaris what attention should be given to the patient's diet?**

Albuminous food should be prohibited and the free use of alkaline waters advised.

**State the uses of nitrate of silver in operative dentistry.**

It is used as a disinfectant, as an obtundant for hypersensitive dentin on exposed surfaces, as a treatment for caries in deciduous teeth; also in ulcerated conditions of the mucous membrane of the mouth.

**Why does the application of nitrate of silver arrest decay in teeth?**

It forms, with the dentinal substance, an impenetrable albuminate of silver which has high antiseptic property.

**What are the uses of sulphuric acid in operative dentistry?**

It is employed to open minute root canals, in the treatment of carious bone, in the treatment of pyorrhea alveolaris as a solvent for concretions upon the root.

**What instruments should receive special attention as**

**regards sterilizing? What means should be employed to effect thorough sterilization?**

All dental instruments should be sterilized. Those more apt to be a source of infection are broaches, drills and all instruments used in pulp-canal treatment.

Broaches and drills should be freed from all adhering matter and with the other instruments placed in Schering's formalin sterilizer.

**Describe the method of examining the teeth of patients and mention the instruments used.**

The instruments used are explorers, mirrors, floss silk and wedges. Beginning at the median line, the surfaces of each tooth are carefully examined with the mirror and explorer. The condition of the sulci and approximal surfaces is carefully noted. The lines of apparent contact are tested with the mirror for evidence of discoloration indicating the presence of decay.

**Describe method of cleansing the teeth.**

The mouth should first be cleansed with a 10 per cent. solution of hydrogen dioxide. With properly shaped scalers all deposits about the teeth should be thoroughly removed. The surface of each tooth is then polished with rubber polishing-cups and finely-powdered pumice; this is followed with a brush and suitable tooth-paste. The teeth and contiguous parts should be sprayed with an antiseptic solution.

**Mention the benefits derived from the use of electricity in dental practice.**

Cataphoresis, drying and sterilizing root canals, transillumination of the teeth and contiguous parts by the electric mouth-lamp. Fusing porcelain and furnishing motor-power for the dental engine, lathe, etc.

**Give treatment of a lower third molar having many grooves or sulci radiating from a common center when**

**caries appears on the occlusal surface or the buccal surface.**

If the buccal surface is not involved, the cavity on the occlusal surface and the radiating sulci should be fully opened and cleared of decay and discoloration. If the buccal surface is involved and the decay extends so near to the occlusal surface that the occluso-buccal wall is weakened, the two cavities should be united.

**Describe the technic of making and inserting a porcelain inlay in a disto-palatal cavity of an incisor.**

The cavity is prepared in the usual manner. An impression is taken with dental "lac" and a cast made of either Spence metal or oxyphosphate cement. From this a matrix is made of platinum one one-thousandth of an inch in thickness. The porcelain body is mixed with distilled water and placed in the matrix with a fine-pointed spatula. The moisture is extracted by means of blotting-paper. The inlay is then carefully dried by holding it at the opening of the muffle, into which it is gradually introduced and biscuited. It is then allowed to cool, placed in the cavity and the edges reburnished.

Porcelain body is again added, carrying it flush with the cavity margins, after which it is dried and baked until a gloss appears. The platinum is then removed, the porcelain grooved with a fine disk and the inlay is ready to be inserted. This is accomplished by means of oxyphosphate cement, which should be mixed to the consistency of cream. The cavity is partially filled with the cement and the inlay forced into it, holding it firmly in place until the cement hardens. The tooth and contiguous parts should be protected from moisture by means of small napkins.

**Describe the condition of the teeth and the appearance of the roof of the mouth in a case of chronic hypertrophy in the nasopharynx.**

The central incisors protrude, one overlapping the other,

their mesial surfaces resting in contact near their incisive edge. The lateral incisors assume a position posterior to the centrals. The roof of the mouth is high and the arch narrow and contracted.

**What do you understand by the term prognathism?**

An abnormal protrusion of the jaws.

**What results are liable to follow the premature extraction of the deciduous teeth? (a) Incisors, (b) cuspids, (c) molars.**

(a) The permanent teeth are liable to erupt in an irregular position; the central incisor taking the position of the deciduous central and lateral, thus forcing the permanent lateral to rest inside the circle of the arch.

(b) The premature loss of the deciduous cuspid allows the erupting lateral and bicuspid to encroach on the space that should be preserved for the permanent cuspid, causing it to erupt in an abnormal position.

(c) The first permanent molar on that side moves forward in the line of the arch, assuming the position that should have been preserved for the second bicuspid.

**Mention a preferable method of annealing gold-foil while introducing a filling. Give reasons.**

By means of the electric annealing tray. The gold can be heated to any desired degree and with a uniformity not attainable by other methods.

**What is the operation "extension for prevention"? How and why is it performed?**

It is the removal of the enamel margins by cutting from a point of greater liability to a point of lesser liability to recurrence of caries.

It is performed by means of chisels, excavators and burs; it is done to prevent a recurrence of caries.





## PROSTHETIC DENTISTRY.

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**What constitutes the basis of Prosthetic Dentistry?**

A thorough knowledge of the science and art of dentistry, together with a high order of manipulative skill.

**How should the mouth be prepared to receive a full artificial denture?**

Diseased teeth and roots should be extracted and the mouth placed in a healthy condition.

**In preparing the lower jaw for artificial teeth, how many, if any, natural teeth should be left in the mouth?**

All teeth in a healthy condition and not interfering with the utility and with the appearance of a denture should be left in the mouth.

**When an impression is required for an artificial denture of any kind, what conditions of the mouth should be considered?**

The size and shape of the jaws, the palate, whether deep or shallow, hard or soft; the alveolar ridge, whether hard or soft, and the relative difference between the hard and soft parts of the mouth; if there are remaining teeth, their condition, whether they are loose or not, or their position such as would require special attention in removing the impression.

**Mention the various materials used for taking impressions.**

Plaster of Paris, modeling composition, gutta-percha and beeswax.

**What are the requisites for an impression material?**

Plasticity, the property of hardening within a short time

while in the mouth and the absence of expansion and contraction, except in a moderate degree.

**What is plaster of Paris chemically? How is it prepared for dental purposes?**

Natural sulphate of calcium less two-thirds of its water of constitution. By roasting and grinding gypsum.

**Describe your method of taking a full upper impression in plaster of Paris.**

A tray suited to the case is selected and a piece of softened beeswax placed across the posterior palatal portion. The patient should sit erect with the head slightly forward, the operator standing at the right of the chair. The cup filled level with the mixed plaster, into which a few grains of salt have been sprinkled, is introduced into the mouth, and pressed up, with the rear in advance of the front. When the parts are completely embedded, pressure should be brought on the lips and cheeks so as to force the plaster well up over the outside ridge. The tray should be held firm until the plaster will fracture with a clear break. The cheeks are now distended with the fingers, the tray is depressed in the back and with a slight forward and downward movement it is removed. Should the impression fracture, the parts are carefully taken away, adjusted to place and held with wax.

**What is the best method of taking a partial difficult impression?**

An impression tray of proper size and shape is oiled and filled with plaster. It is introduced into the mouth and forced well up. When the plaster is hardened, the tray is detached from the impression and removed from the mouth. With a blunt instrument the sides and front of the impression are broken away, after which the portion covering the palatal surface is taken out. The pieces are then placed in the tray and joined with wax.

**What are the qualities of a good impression? Give test.**

A good impression must have fulness, smoothness and

sharpness. It should cover a little more surface than the finished base-plate; it should reproduce exactly the finest lines and be as smooth as the mucous membrane.

The best test of a good impression is the degree of resistance offered to its removal.

**How may nausea be prevented in a particularly sensitive mouth while an impression is being secured?**

By gargling the throat with camphor water just before taking the impression, or by painting the parts with a one per cent. solution of cocaine.

**State the two essential requirements for the production of a perfectly-fitting denture.**

An accurate impression and model.

**How soon after a plaster impression is taken should the plaster be poured for the model? Give reasons for your answer.**

The model should be run within a few hours from the time the impression has been taken, or before the latter becomes too dry. Thus expansion or porosity, as well as crystallization of the salt on the surface of the cast is prevented.

**How may plaster teeth on models be strengthened to prevent fracture?**

By forcing pins into the teeth cavities of the impression before the model is poured.

**How should a plaster model be treated when a portion of the ridge is soft and the center of the mouth hard?**

The cast should be scraped at the portion corresponding to the soft portion of the ridge and the center should be relieved by a strip of lead or tin a thirty-second of an inch in thickness.

**What properties are requisite for a good base plate?**

It should possess the property of malleability or of being rendered soft when subjected to heat, while at the same time it should be unaffected by the temperature of the mouth.

**Describe the method of obtaining a correct bite for a full upper and lower set.**

To the upper and lower base plates, which have been accurately fitted to the models, a rim of softened beeswax is attached, sufficient to secure the fulness and length of the teeth to be inserted. The rims are neatly trimmed and the trial-plates placed in the mouth. After the proper length, contour and correct apposition of the rims have been obtained, the patient is directed to swallow and bite. This is repeated several times to assure accuracy. The median line is then marked, the rims are united with a hot spatula and the two articulating models removed together.

**What relation should the artificial teeth bear to the alveolar ridge?**

The long axis of the teeth should be in line with the vertical axis of the alveolar ridge.

**What general principles should be observed in arranging artificial teeth for an edentulous mouth?**

The teeth should be arranged so as to restore the expression of the mouth and face.

They should occlude properly and be placed as near the center of the ridge as possible.

**What relation in regard to length should (a) the upper teeth bear to the upper lip, (b) the lower teeth bear to the lower lip?**

(a) The superior teeth should extend below the upper lip sufficient to show the tips when the mouth is opened without raising the lips.

(b) The lower teeth should be a few lines shorter than the lower lip, or so that they are not visible when the mouth is in a passive state.

**In Prosthetic Dentistry what is meant by "re-posing the features."**

By the term "re-posing the features" we include every-

thing necessary to bring each and all of the visible parts of the face and mouth into harmony of relation to each other. (Warren: "Dental Prosthesis.")

**In full dentures, are the upper or the lower teeth first arranged on the model? Give the general arrangement.**

The anterior inferior teeth are generally arranged first. All the teeth except the inferior incisors and the superior second molars should have two antagonists in articulating.

The anterior superior teeth, beginning with the central incisors, should incline slightly towards the median line, which should divide the space between the centrals. The lower teeth should stand nearly straight, the cusps of the bicuspid and molars occluding inside the cusps of the superior bicuspid and molars. The occlusion should be even on both sides.

The relative length of the teeth is governed by the articulating models.

**In articulating a full denture, what teeth should bear the greatest pressure of the bite?**

The bicuspid and first molars.

**State the value of the study of temperaments in the practice of Prosthetic Dentistry.**

It enables the dentist to select teeth the size, shape and color of which conforms to nature's type in the physical organization.

**Describe the size, form and color for (a) a bilious, (b) a sanguinous, (c) a nervous, (d) a lymphatic temperament.**

(a) Large, rather long in proportion to breadth, angular; color, deep yellow.

(b) Well proportioned, length slightly predominating over width; color, cream-yellow.

(c) Length greater than breadth; fine, long cutting edges; color, pearl-blue or gray, inclined to translucency.

(d) Large, breadth greater than length, poorly shaped; color, opaque and pallid.



**Explain how an entire upper denture is retained in position.**

By atmospheric pressure or adaptation.

**What is the value of relief spaces as compared with vacuum chambers in full upper dentures?**

By relief spaces maximum adaptation is secured and possible irritation to the tissues avoided.

**What is the Cleaveland vacuum-cavity?**

It is a soldered vacuum-cavity, the cap being a little larger than the opening cut in the plate.

**What relation should the vacuum-chamber bear to the center of gravity? \***

It should be placed at the center of gravity.

**How would you find the center of gravity of the palatal vault on a model of an edentulous upper jaw? \***

The center of gravity can be found by drawing lines from the centers of both condyles to the junction of the first and second bicuspids on each side. At the point on the median line where the lines intersect will be the center of gravity.

**What nerves may suffer from the sharp anterior edge of an improperly placed vacuum-chamber?**

The naso-palatine nerves.

**What muscles have a tendency to displace (a) an upper denture, (b) a lower denture?**

(b) Buccinator.

(b) Mylo-hyoid and geniohyoglossus.

**How may the pressure of an upper artificial denture be equalized when portions of the mouth are very hard and portions very soft?**

By relieving the impression at such places as correspond

\* "Centre of gravity" as applied to an upper denture seems a meaningless expression. The vacuum-cavity should be situated at about the centre of the area covered by the plate.



to the hard portions of the mouth, and by scraping the cast at such points as correspond to the soft portions of the mouth.

**How may a plate be prevented from rocking in a mouth with a hard palatal ridge?**

By relieving the entire central portion of the plate.

**Mention the three principal ingredients used in manufacturing teeth and state which one gives the translucency and lifelike appearance to the teeth.**

Kaolin, feldspar and silex. The feldspar is used to produce the enamel and to give it translucency.

**What metal is used as a coloring agent to produce the grayish-blue tint of the enamel of artificial teeth?**

Platinum.

**What is Purple of Cassius and for what is it used in porcelain?**

It is a mixed oxide of gold and tin, and is used to produce the gum color in porcelain.

**What color is produced by titanium in porcelain enamel?**

Yellow.

**Describe the difference between long-bite teeth and short-bite teeth. Mention cases where each would be appropriate.**

In long-bite teeth the distance between the cutting edge and the pin-guard (the ridge or shoulder of porcelain extending across the lingual surface of the tooth, which indicates the extent of the lap of the upper incisors over the lower) is greater than that in the short-bite teeth, where the ridge is closer to the cutting edge.

Short-bite teeth are indicated where there is a long ridge and a short lip; long-bite teeth, where the alveolar ridge is short, and the lip long. Short-bite teeth are also indicated where there is but little overlap of the antagonizing teeth, and long-bite teeth where the overlap is more marked.

**What are the relative merits of plain teeth and gum sections? State where each should be used.**

Plain teeth can be more artistically arranged than gum sections. They should be employed only where the teeth are to rest directly upon the natural gum, or where the length of the lip is sufficient to conceal the artificial rubber gum.

Where the lip is short and the gum is more or less exposed while laughing or talking, or where there has been considerable resorption of the ridge and greater fulness is required, better results are obtained with gum sections.

**Where can pinless or diatoric teeth be advantageously used?**

In cases which do not require grinding of the porcelain. In cases where they are not required to set close to the alveolar ridge. If ground, the undercuts are weakened, and if set close to the ridge, their shape does not allow of sufficient vulcanite to make a strong denture.

**How soon after extraction of the teeth should full temporary dentures be inserted? permanent dentures?**

Temporary dentures may be inserted immediately or soon after the extraction of the teeth; permanent dentures after complete resorption has taken place, which usually requires from six to twelve months.

**What are the advantages of countersunk-pin teeth?**

Their close conformity in contour to the natural organs makes them more acceptable to the tongue, renders articulation easier and more distinct, and, when properly mounted, they present a naturalness of appearance seldom obtained with the other varieties.

**Why is a temporary denture desirable?**

To preserve the natural expression of the lips as well as the normal position of the lower maxilla.

**Does absorption of the alveolar process advance more rapidly with or without a plate?**

With a plate.

**What causes dark joints in gum teeth? How can this be prevented?**

The entrance of rubber or of foreign substances between the joints.

It can be prevented by grinding the joints so that their surfaces come in perfect contact, thus avoiding a V-shaped space, and by the use of a very hard-setting plaster for flasking. Soft cement placed over the joints will also prevent the entrance of foreign substances.

**State what causes gum sections to break in the flask?**

The presence of too much rubber and excessive force in screwing down the flask.

**Name the various materials used as a base for artificial dentures.**

Rubber, aluminum, silver, gold, platinum, celluloid, continuous gum and porcelain.

**What base for an artificial denture do you consider hygienically the best and why?**

Porcelain or continuous gum. It is hygienically the best because of the absence of porosity and of spaces for the accumulation of food.

**Where and how is crude rubber obtained?**

Crude rubber or caoutchouc is a milky exudate obtained by tapping the *Siphonia elastica*, a South American tree.

**What is the substance known as vulcanite?**

Caoutchouc and sulphur submitted to the process of vulcanization.

**Name the principal solvents of rubber.**

Ether, chloroform, kerosene, and the essential oils.

**What is the coloring pigment in red vulcanite, black vulcanite, pink vulcanite?**

The coloring pigment in red vulcanite is vermilion; in black vulcanite, ivory-black; in pink vulcanite, white oxide of zinc and vermilion.

**How may vulcanite be bleached?**

By placing it in absolute alcohol and subjecting it to the rays of the sun.

**State the amount of caoutchouc and of sulphur used in making vulcanizable rubber suitable for dental plates.**

Caoutchouc, 48 parts; sulphur, 24 parts.

**What causes the tissues to inflame under a rubber plate?**

The generation of heat due to the rubber being a negative electric and the irritating action of the coloring matter in the red rubber—mercuric sulphide (vermilion).

**State the reasons for using black, red and pink rubber.**

When red rubber irritates the tissues, black rubber should be used. Pink rubber is employed in the anterior part of the mouth, because it approximates the color of the gums.

**What is weighted rubber, and where is its use indicated?**

Rubber in which tin filings are incorporated. It is employed in lower dentures, to be used in mouths where there is little or no ridge and where weight is essential to the retention of the plate.

**At what degree of heat and how long should a rubber denture be vulcanized in order that the best results may be obtained?**

It should be vulcanized for fifty-five minutes at a temperature of 320° F.

**What part of an upper denture has the greatest influence on the expression of the face?**

The anterior part.

**What are plumpers? Where placed? State their use.**

Plumpers are rolls of vulcanite placed on the labial and buccal rim of the denture. They serve to restore the features of the face.

**What is the guide for the amount of rubber to be used in packing a case?**

The wax from the model plate is placed in Starr's measuring-glass which is half filled with water, noting the height to which the water rises. The wax is then removed and sufficient rubber is put into the glass to raise the water to the same level or a little higher.

**Describe the method of constructing an artificial denture on a vulcanite base.**

An impression of the mouth is taken in plaster of Paris, from which is secured a plaster model. If an air-chamber is required, it is cut from sheet tin and secured in position on the model. A base plate of modeling compound is made to conform to the model. To this is attached the wax guide or rim, which is trimmed to the desired width, fulness and contour. This is placed in the mouth and the bite secured, after which it is returned to the model and, with the antagonizing model, is placed in the articulator. The teeth are arranged and waxed on this temporary plate, which is carved and trimmed just as the finished plate is desired to be. The model, with the plate, is removed from the articulator, the plaster trimmed, moistened and invested in the lower half of the flask, the plaster extending to the external rim of the wax. The plaster is then smoothed and varnished and the upper section of the flask placed in position and filled with plaster. When the plaster is hard, the flask is heated sufficiently to soften the wax, and the parts are separated. The wax is then carefully and completely removed by pouring a stream of boiling water into the flask and over the teeth.

After the flask has dried for a few minutes, the vents are cut and the two halves of the flask placed on the stove and



heated to about the boiling-point of water. The ease is now ready for packing. The rubber is cut in strips and thoroughly warmed; small pieces of the pink, packed between the teeth and strips, wide enough to extend from above the pins to the edge of the plate, are placed in position. The pins are completely covered with the red rubber, which is also placed over the palatal portion. No. 3 tin-foil is burnished to the model and coated with a solution of soap, which facilitates the removal of the foil from the vulcanite. The flask is closed and heated sufficiently to soften the rubber; the parts are then screwed together. The ease is vulcanized, and when thoroughly cool, the plate is removed, filed, scraped, sandpapered and polished.

**With a protruding lower jaw, how far toward the tongue may the lower teeth be placed? What relation must they bear to the alveolar ridge?**

The lower teeth should not be placed towards the tongue farther than the center of the edentulous ridge.

They should be arranged as close to the center of the alveolar ridge as possible.

**When would you arrange the teeth of an upper plate to occlude directly on the cutting edges of the lower teeth?**

In a case of a person of advanced age, where the lower teeth are so abraded that the masticating surfaces are perfectly flat. The cusps of the upper artificial teeth should be ground off and the surfaces roughened.

**When a vulcanite upper plate cracks, why does the crack usually occur near the median line?**

It is due to the improper arrangement of the molars, in consequence of which the strain of mastication is thrown on the outside instead of on the top of the ridge. Imperfect vulcanization, also insufficient rubber behind the incisor teeth, are factors in the cause of plates cracking at or near the median line. It may be due to resorption of the ridge subjecting the plate to undue strain.



**How should faulty articulation of artificial teeth be corrected?**

When the articulation is slightly faulty the interfering points can be detected by placing a strip of carbon paper in the mouth and instructing the patient to bite; the points thus marked should be removed with a corundum-stone. If the articulation is seriously faulty, the denture should be re-made.

**State how the setting of plaster may be hastened?**

By the addition of a few grains of common salt to the mixture.

**Mention some of the causes of failure of artificial dentures.**

Imperfect impression or cast, inaccurate articulation and warping of the plate.

**Give a method of correcting a warped vulcanite rubber plate.**

A cast of the mouth is secured and thoroughly dried. The portion of the plate that needs correcting is heated over a spirit-lamp sufficiently to render the vulcanite flexible. It is then placed on the model, held firm, and with a heavy burnishing instrument the plate is adapted to the cast.

**State the effect of a hard center and a soft ridge on the fit of an upper denture.**

Unless the hard center is properly relieved, the plate will rock.

**A common result of wearing lower plates that accurately fit a model, is a tendency of the plates to bury their buccal edges in the soft tissues; state how this tendency may be overcome.**

By cutting away the buccal edge until the plate, when in the mouth, will not bear on the soft tissues.

**Mention some of the various methods of retaining artificial dentures.**

Atmospheric pressure and clasps and springs.

**Give the normal occlusion of the teeth.**

All of the superior teeth overlap the lower; the six superior anterior teeth extend over and cover part of the labial surface of the six inferior teeth. In the buccal region the buccal cusps of the superior bicuspid and molars cover the buccal cusps of the inferior bicuspid and molars. Each tooth, except the inferior central incisors and the last superior molar strikes against two opposing teeth.

**What is your method of repairing a rubber plate fractured through the center?**

The two parts of the plate are adjusted together and held by means of hard wax dropped on the lingual surface. The palatal portion is then oiled and filled with plaster. When the plaster has hardened, the plate is removed from the model and the line of fracture enlarged with a file. With a jeweler's saw, dovetails are cut opposite each other, after which the parts are placed on the model and the prepared spaces filled with wax. The case is invested in the usual way, packed and vulcanized.

**Give the method of polishing a vulcanite plate on the palatal surface.**

Little or no polishing should be done to the palatal surface of a plate. A smooth, bright surface can be obtained by burnishing No. 3 tin-foil to the model and coating this with a solution of soap, just before the flask is closed prior to vulcanizing.

**How may a gold clasp be attached to a rubber plate?**

By soldering a perforated gold tongue to the clasp in such a way that it will be well embedded in the rubber when the plate is finished.

**What would result if an upper denture extended too far posteriorly and touched the soft palate?**

The muscles of the soft palate would displace the plate during the act of swallowing. It is also apt to cause retching.

**Describe a method of producing a very thin and rough vulcanite plate, both surfaces of which will be nearly finished when removed from the flask.**

The case is prepared for flasking in the usual manner; it should be smooth and as thin as the finished plate is intended to be. No. 60 tin-foil is burnished to the wax; it should be applied in two pieces, one for the lingual surface and one for the buccal and labial surface. The edges of the tin-foil are bent out sufficiently to escape the investment in the lower section of the flask and, at the same time, so as to be grasped by the plaster when the upper section of the flask is poured. The case is then flasked. When the plaster is hard, the flask is placed in warm water to soften the wax; it is opened, the wax removed and boiling water poured into the flask and over the pins. No. 3 tin-foil is burnished to the cast and soaped. The waste-gates are cut and the flask dried, heated, packed and vulcanized in the usual manner.

**Can rubber be vulcanized in direct contact with silver? Give explanation.**

Rubber cannot be vulcanized in direct contact with silver owing to the affinity of the sulphur in the rubber for the silver.

**State a method of treating silver so that rubber can be vulcanized in contact with it.**

The silver may be gilded or coated with tin.

**Describe the method of using "Victoria" or other metal to strengthen or reinforce vulcanite partial dentures.**

When "Victoria" metal is used, it is cut to the desired size and made to conform to the shape of the mould, placing it so that the roughened surface will be embedded in the rubber, which is packed directly over the metal. When a bar is used, it is embedded in the rubber during the process of packing, so as not to show in the finished plate.

**What will be the effect on a rubber plate if it is vulcanized for twenty-four hours at 320 degrees F.?**

The rubber will become dark and very brittle.

**Describe the process of constructing an artificial denture on a celluloid base.**

The plaster impression secured, a metal cast is obtained by running the impression in block tin. If a vacuum-chamber is required, it should be cut in the impression before the model is poured. Taking the bite, articulating the case and arranging the teeth is the same as for rubber work.

The base-plate is made of paraffin and wax compound. With a curved knife-blade the wax on the lingual surface and on the labial and buccal surfaces is carved so as to reproduce the natural characteristics of the gums. The wax is made smooth by passing it over the flame of a small burner. No. 60 tin-foil is then burnished over the surface of the wax. The case is ready for flasking; it is invested in the shallow half of the flask designed for this work. The plaster must extend just to the borders of the plate. When hard, it is trimmed and coated with liquid soap. The deep portion of the flask is adjusted and filled. When the plaster is hard and after sufficient heat has been applied to soften the wax, the two sections of the flask are separated. The wax is thoroughly removed by pouring a stream of hot water over the mould. A groove to permit of the escape of surplus material is cut in the plaster encircling the matrix, but not connected with the mould. A celluloid blank of the desired size is selected and made to conform to the shape of the mould by heating it in boiling water and pressing it with the fingers into the section containing the teeth. The flask is then closed and placed in water so as to saturate the plaster. The case is ready for moulding, using the hot, moist-air machine. The flask is placed in the clamp and the top screwed down until it presses the flask, after which it is put in the tank and the heat applied. When the temperature raises to 225

degrees F., slight pressure should be applied, and as the heat increases and the celluloid becomes more plastic the pressure is increased. This is continued until the flask is completely closed. The heat is then turned off and the piece allowed to cool gradually. When perfectly cold, the sections of the flask are separated and the plaster and tin-foil removed from the case, which is now trimmed and polished, employing the same instruments as used in rubber work.

**Give the composition of celluloid.**

Pyroxylin, camphor, oxid of zinc and vermillion.

**Describe the method of constructing a lower artificial denture made by the cheoplastic process.**

From a plaster impression a cast of equal parts plaster and marble dust is secured. The steps concerned in this method are the same as for rubber work up to the flasking. In a flask designed for this work the case is invested, using equal parts of plaster and marble dust as investment material. After the investment is hard, the sections of the flask are separated and grooves cut from the posterior margin of the mould to the openings of the flask. All traces of wax are removed by boiling water. The mould is then thoroughly dried by placing the two halves of the flask over a low heat for an hour or more, after which the parts of the flasks are placed together and clamped tight. The fusible alloy is then melted and poured into the mould through one of the openings of the flask. When cold, the case is removed, smoothed with files and sandpaper, and polished with pumice-stone.

**Give the essential properties of metals used for dies.**

Hardness, low fusibility, a minimum of contractility, and ability to withstand the force used in swaging.

**Define die, counter-die. Mention the best metals for each.**

A die is a metal duplicate of a model. A counter-die is a cast, the counterpart of a die.



Zinc and Babitt metal are used for dies; lead for counter-dies.

**Of what is Babitt metal composed?**

Of copper one part, antimony two parts, tin eight parts.

**Give the fusing-points of tin, zinc, and lead.**

Tin about 460° F., lead about 617° F., zinc about 773° F.

**Describe a Hawes molding-flask and state why it is used.**

It is composed of two sections or rings. The lower consists of three moveable pieces with extensions projecting towards the center, and which are held together when in use by means of pins passing through openings in the joints. The upper section is a plain ring which fits on the lower.

It is used for securing moulds or casts with deep undercuts.

**Describe the method for making and using cores to obtain accurate moulds from models with deep undercuts.**

The surface of the undercut on the cast is oiled. A mixture of marble dust and plaster is run into the undercut and the wall of the model is extended so as to slant to the base of the cast. When this is hard it is detached from the model and thoroughly dried over a stove, after which it is placed in position on the model and the mould made, the outlines of the core being plainly marked. The core is then removed from the model and placed in its position in the mould and the metal poured.

**Describe a method of obtaining a correct die from a lower model that has several anterior teeth standing, the jaw very much undercut lingually below the neck of the teeth.**

The undercut on the model is overcome by means of two cores joining at the median line. A mould is then made, the cores are removed from the model and placed in position in the mould, which should be thoroughly dried and the metal poured.



**State the uses of aluminum in dentistry. Describe the method of annealing.**

Aluminum is used as a base for artificial dentures and for shell crowns. It is annealed by coating the metal with oil and holding it over a Bunsen burner until the oil is burned off, leaving a white surface.

**State two methods of using aluminum in the construction of artificial dentures.**

The method of swaging and of casting.

**Describe the method of making an upper denture on swaged aluminum, the teeth to be attached with rubber.**

The die and counter-die secured, aluminum plate of twenty gauge is annealed and swaged the same as gold. The surface to which the rubber is to be attached is roughened and perforated. The bite and articulation secured, the teeth are arranged in the usual manner. The case is invested in the lower section of the flask, the plaster extending to the wax rim and imbedding the exposed metal surface (the palatal portion of the plate). When the upper section of the flask is run and the plaster is hard, the flask is placed in warm water to soften the wax. It is opened, the wax removed, and boiling water poured over the teeth and over the plate. The roughened surface of the plate should be washed with absolute alcohol to remove all traces of the wax. The case is packed and vulcanized in the usual way. The rubber attachment is finished as usual; the metal is polished with fine pumice and rouge.

**What is the fusing-point of aluminum?**

1160° F.

**Give a formula of aluminum solder suitable for dental purposes.**

Tin .....	55 parts.
Zinc .....	23 "
Silver .....	5 "
Aluminum .....	2 "

**Give two methods of swaging a metal plate.**

A plate cut to the proper size is annealed and placed on the die; with a horn mallet the posterior part of the plate is driven into position; by this means the central part of the plate is brought in contact with the die at its deepest portion. The plate is cleansed, re-annealed and placed on the die; with a partial counter-die the palatal portion of the plate is now swaged, using a heavy swaging-hammer. The plate is again annealed, placed on the die and swaged with a counter-die extending over the alveolar ridge. The third swaging is done with a counter-die that extends beyond the plate line. Any wrinkles which have formed are removed by means of the horn mallet.

The Parker's swaging device: The plate is first roughly swaged by means of a die and counter-die and adjusted to the plaster model. In this position it is placed in a cast-iron cylinder and covered with fine bird-shot; this should nearly fill the cylinder. Over this is placed the plunger, and with a few blows from a heavy hammer the plate is brought into accurate apposition with the plaster model.

**What gauge of gold plate is used for an upper denture? What for a lower? State carat.**

26 gauge for an upper denture and two thicknesses of 30 gauge each for a lower.

18 or 20 carat.

**What is the result of over-annealing of gold or silver plate?**

The surface of the metal fuses, thus destroying its texture and rendering it more or less brittle.

**What causes gold and silver plates to warp while soldering? How can it be prevented?**

The warping is due to the contraction of the solder and the want of support when heated, or from excess of investing material. It can be prevented by having the plate well

imbedded in the investment, avoiding the use of more material than is needed to make a wall a half-inch thick around the teeth.

**What method should be used to correct a slightly warped plate with teeth in order to fit a plaster model?**

The plaster model should be dried so as to make it perfectly hard. The plate is placed upon the model and the defective portion carefully noted. With a few carefully-directed blows from the bench-hammer the plate can be brought in contact with the cast.

**Describe the method of forming a rim of a full upper gold plate.**

A plaster impression of the gum surfaces of the teeth and the exposed border of the plate is taken in two sections, each extending from the median line to the heel. From this are secured models. Dies and counter-dies are obtained, and strips of plate of sufficient width are swaged, fitted to the plate and trimmed, after which the rims are held together with small clamps and soldered.

**State the precaution that should be taken to prevent gold plate from cracking during swaging.**

Frequent annealing.

**Describe the method of constructing an artificial denture on a gold base using single gum teeth.**

The plaster cast is scraped along the posterior margin of the plate line so as to increase the bearing of the plate at this point. The die and counter-dies are secured, the plate is well annealed and swaged. The vacuum-chamber is cut out and one, swaged up separately, is soldered in. The bite and articulation are secured and the models adjusted in the articulator. The teeth are ground to fit the plate accurately, allowing a minute space between the blocks for expansion. The plate with the teeth waxed in place is invested in an investment of plaster and sand, equal parts. When the plaster

is hard, the wax is removed and the backings are adjusted to the teeth, care being taken to have them in direct contact with the plate. The platinum pins are split and spread apart to hold the backings securely in place. The case is then boraxed and heated preparatory to soldering. When it is heated to redness, it is removed, placed on a soldering-block and soldered. When cool, the plaster is removed and the plate placed in a bath of sulphuric acid, after which it is smoothed and polished.

**How is gold solder confined to the desired surface?**

The parts to be kept free from solder are coated with a paste of whiting.

**Why is flux used?**

To free the surface of oxides.

**What is the proper method of directing the flow of the solder?**

The application of borax and the management of the blow-pipe.

**Describe the construction of a gold plate with rubber attachment.**

The plate is made and the teeth arranged precisely as they would be for a denture where the teeth are backed and soldered, except that teeth suitable for vulcanite work are selected. Either before the teeth are arranged, or after they have been waxed to the plate and adjusted in the mouth, a triangular gold wire about No. 18 gauge is soldered around the alveolar border of the plate to a little beyond the last molar of each side, where it should cross the ridge and be extended along the inner or lingual line or border of the rubber attachment. The object of this wire is to strengthen the plate, and also to hold secure the edges of the attachment and prevent them curling up, as otherwise they are apt to do after the denture has been worn for some time. To secure the rubber attachment to the plate, gold or platinum

pins or wire loops are soldered on the ridge, inside the line of triangular wire; they should be so arranged as not to interfere with the teeth nor to show through the rubber after the denture is finished. If this is done after the teeth have been arranged, plaster guides should be made before the position of the teeth has been disturbed, so that they can be accurately returned to place after these additions to the plate have been made. The plate is now smoothed, the teeth arranged, and wax built out and contoured precisely as the rubber attachment is desired to be. The case is flaked so that the gold plate will be in the bottom portion of the flask and the teeth in the upper. It is now packed, vulcanized, and finished as would be a vulcanite denture.

**Is a gold lining in a vulcanite plate beneficial? Explain.**

It is, in so far as the gold prevents any irritation of the tissues from the rubber.

**How may an old plate be lined with gold?**

The surface of the plate to be covered with the gold is thoroughly cleansed with soap and water, after which the entire surface is roughened with a sharp-pointed instrument. A solution of rubber and naphtha is painted over the roughened surface and allowed to dry to the point of stickiness. Strips of No. 60 gold foil, one side of which have been roughened by the electro-deposition of gold, are cut of sufficient size to form the rim. Where there are depressions, the lining should be pressed with a suitably-shaped piece of rubber eraser to the lowest point in the plate. Each strip should slightly overlap the other, care being taken to avoid wrinkling. The plate is then flaked in the usual way and vulcanized for twenty-five minutes at from 320° to 330° F. It will require no finishing except where the edges of the lining overlap.

**What are English tube teeth? Describe a method of attaching them to a gold plate.**

They are a class of plain teeth made with a platinum tube



baked in the porcelain, extending through the center of the tooth and corresponding to its long axis.

The English tube teeth are attached to a gold plate by first grinding them to fit the position they are desired to occupy. They are held in place by means of hard wax. A marking-wire, tipped with vermilion paint, is passed down each tooth till it touches the plate. This marks the place at which the holes are to be drilled to receive the pins. The teeth are removed and the holes drilled. Gold pin-wire of the desired length is cut and the end to be inserted into the drilled hole is tapered so as to fit tight and project through on the palatal surface. The tapered end of the pin and the pin-hole are then boraxed and the pin soldered to the plate. The teeth are then placed on their respective pins and the final adjustment made. Previous to attaching the teeth to the pins, shallow grooves are made in the latter with a fine file. The teeth are thoroughly cleansed, dried and replaced on the pins. In a small porcelain receptacle sulphur is melted, and with a wire spatula the sulphur is conveyed to the plate, which is kept heated by holding it with the pliers over a burner. The sulphur runs under the teeth and along the pins. When cool, it sets hard and the teeth are immovable. (American Textbook of Prosthetic Dentistry.)

**Describe a method of constructing a partial lower denture of gold, the teeth of which are soldered to the plate, the six anterior natural teeth being in the mouth.**

The die and counter-die are made, and a pattern of the desired plate is obtained in tin-foil. From this is cut two plates of gold, 18-carat fine and 30 gauge in thickness. The plates are annealed and swaged separately, the under plate being a little larger than the upper and both extending one-half on the lingual surface of the anterior teeth. The plates are trimmed, re-annealed and swaged together. After boiling in the acid solution, the surfaces to be soldered are polished and boraxed. They are then placed in apposition, heated to redness, after which they are placed between the



die and counter-die and with a few blows from the swaging-mallet are brought in absolute contact. The plates are then soldered with 18-carat solder. The plate is now polished, placed in the mouth, the bite taken, and with the antagonizing model mounted in the articulator. The teeth are ground to fit the plate accurately and the backings adjusted to each. With hard wax the teeth are now attached to the plate and the case invested in a mixture of plaster and asbestos fiber. When thoroughly dried, it is heated to redness and soldered. The case is allowed to cool gradually until perfectly cold, when it is removed from the investment, boiled in the acid solution and finished with files and fine stones, using pumice and rouge for polishing.

**Give method of strengthening an upper or lower gold plate behind the anterior teeth.**

A duplicate plate, extending from the position of the bicuspid of one side to the bicuspid of the other is swaged and soldered to the plate proper. The reinforcement for the lower plate should be the same width as the plate; for an upper plate it should extend an eighth of an inch from the festooned margins to a point within the same distance of the edge of the vacuum-chamber.

**What is the method of repairing a cracked plate of gold?**

The parts to be soldered are cleansed. The crack in the palatal surface of the plate is covered with a layer of gold-foil and the case invested. A piece of plate is then placed over the crack and made to conform to the shape of the portion of the plate to be repaired. The investment is then dried and the case heated and boraxed, after which solder is flowed between the two plates.

**Can you solder 18-carat plate with 18-carat solder? Explain.**

Yes. The alloy of the solder being a low-fusing metal, the solder fuses at a lower temperature, although the plate and solder are of the same fineness.

**Describe the process of sweating together two pieces of gold plate of the same degree of fineness.**

The pieces are placed in apposition and, by careful manipulation of a broad, full flame of the blowpipe, the plates are united by partial fusing of the surfaces in contact.

**Give the fusing-point of gold, silver, copper.**

Gold, 2016° F.; silver, 1873° F.; copper, 2000° F.

**Give the formula for 20-carat gold plate.**

Pure gold, 20 dwts.; copper, 2 dwts.; silver, 2 dwts.

**Which is finer, 20-carat plate or 20-carat solder? Which fuses at the lower degree of heat? Why?**

They are of the same fineness. The solder being alloyed with a low-fusing metal, fuses at a lower temperature than the plate, although they are of the same fineness. (Dr. Wm. H. Trueman.)

**Give a formula for a 22-carat solder.**

Gold .....	22 parts.
Copper .....	1 part.
Silver.....	$\frac{3}{4}$ of 1 part.
Zinc .....	$\frac{1}{4}$ of 1 part.

**What is the difference between platinous gold and platinized gold?**

Platinous gold is the alloy of gold and platinum. Platinized gold is gold covered with platinum.

**What would be the effect of placing a piece of lead on a gold plate during the process of annealing?**

It would impair the ductility of the gold or destroy the plate at the spot where the lead fuses on the gold.

**What effect has zinc on gold solder?**

It makes it flow easy. Impure, or commercial zinc also makes solder brittle. If the zinc is chemically pure it does not have this effect.

**Express in carats the fineness of American gold coin.**

21.6 carat.

**Give formula for clasp gold.**

Pure gold.....	20 dwts.
Fine copper .....	2 “
Fine silver.....	1 dwt.
Platinum .....	1 “

**Give a method of making a gold clasp. State thickness of the metal used.**

From an accurate model of the tooth a pattern is made of heavy pattern-tin. This is reproduced in clasp-metal, 24 gauge. The edges are filed to conform with those of the pattern, and the metal, well annealed, is shaped with round-nose pliers.

**Give method of attaching a clasp to a gold plate.**

The clasp is adjusted to the tooth in the mouth. The plate is placed in its position, and with a plaster impression the plate and clasp are removed. The model is obtained and the clasp attached to the plate with hard wax. They are then removed from the model and embedded in a mixture of plaster and sand. The case is then dried and soldered.

**Should a gold clasp be used about a tooth containing a large amalgam filling?**

There are objections. In some mouths the contact of the two metals may cause more or less galvanic action; this is, however, usually but temporary.

**What kind of a denture should be constructed in the case of a patient whose superior canines and second molars are in position?**

A horse-shoe plate of gold or vulcanite retained in position by clasping the second molars.

**How are porcelain teeth attached to a metallic base?**

By means of vulcanite or by backing the teeth and soldering them to the metallic base.

**Why is platinum used for pins in teeth?**

Because it expands less under heat than any other metal and possesses the property of fusing at a high temperature.

**What is the fusing-point of platinum?**

3500° F.

**How would you solder platinum?**

By means of pure gold or an alloy of gold and platinum.

**What are the advantages of continuous gum?**

Cleanliness, natural appearance, durability. It is non-irritating and easy of repair.

**Describe the method of constructing a continuous gum denture.**

A platinum plate, 29 gauge for the upper or 26 for the lower denture, is swaged the same as in gold work. The outer edge is reinforced with No. 19 gauge, half-round platinum wire, bent to fit the plate along the alveolar edge to about an eighth of an inch from the posterior edge of the plate; this is soldered with pure gold.

To the posterior edge of the plate a strip of platinum one-eighth of an inch wide is swaged and soldered, turning up the inner edge before soldering. The bite is taken in the usual way. The teeth (continuous gum teeth) are arranged and secured with hard wax. They are then coated with an alcoholic solution of shellac and the case is embedded in an investment of plaster and asbestos. When the investment is sufficiently hard, the wax is removed and the plate and the pins are thoroughly cleansed for soldering. Strips of platinum of the same gauge as the plate are then fitted to the palatal surface of the teeth, extending from the pins to the plate. The pins are then bent down over the strip, holding it firmly in place.

The case is now boraxed, slowly heated, and when brought to a red heat it is removed and soldered with pure gold. When cool, the plate is taken out of the investment, cleansed

and adjusted to the mouth. If satisfactory, the body is then applied.

The body is mixed with a solution of gum-arabic and water, and with a small spatula it is packed around the necks of the teeth and spread over the surface of the plate. The gum is stippled to give a natural appearance. The moisture is absorbed with a linen cloth, and with a fine blade clean cuts are made between the teeth extending through the body and over the surface of the plate, in order to prevent distortion of the plate by the shrinkage of the body.

The plate is now placed upon the investment material and thoroughly dried, after which it is conveyed to the mouth of the heated muffle, into which it is gradually introduced. The muffle is brought up to a white heat, and when the body presents shiny crystals the heat is turned off and the case allowed to cool gradually. When thoroughly cold, it is placed on the die and the incisions and cracks in the body packed solid with new body. The gum enamel is then applied. Tapping the plate gently will bring the moisture to the surface, which can be absorbed with a napkin. The case is dried and baked, using a higher temperature than for the first baking. The case is cooled as before and the metallic surface polished.

### **What is meant by "stippling"?**

Dotting the tin-foil which is burnished over the wax gum with a dull-pointed instrument. By this means a more natural appearance is produced on the gums of the finished denture.

### **State the method of replacing a tooth broken from a denture of continuous gum.**

The remains of the broken tooth and the contiguous porcelain are ground away and a new tooth fitted in place. New body is then packed around the tooth, the case dried and biscuited. When sufficiently cool, the gum enamel is applied and the case baked until it becomes smooth and glossy.



**About what degree of heat is required to fuse porcelain in continuous gum work?**

About 2200° F.

**In continuous gum or other work in which porcelain is used what is the cause of the porosity sometimes found on breaking the piece?**

Insufficient baking, or over-heating.

**Describe the construction of an upper denture of porcelain.**

Two casts are taken from a plaster impression of the mouth and a thin lead plate is burnished to one of the casts. Softened beeswax is then placed on the ridge and the articulation obtained in the usual way. The cast and the articulating model must then be enlarged to allow for the contraction of the porcelain in burning. To accomplish this, the cast and articulation are divided into four sections with a thin saw. The first division is made at the center, along the mesial line, to the back of the cast; the second division back of where the cuspid teeth are located. Before cutting the cast, the bottom should be made smooth and level. After the case has been divided, the sections are placed together, leaving a space of a quarter of an inch between each. This is filled with freshly-mixed plaster, the sections being held in position by wax. When the plaster is hard, a new lead plate is cut and burnished to the cast. The sections of the wax articulating model are placed on the enlarged cast and the interspaces filled with melted wax; thus the model conforms to the size of the enlarged cast.

An outside wall is now made for moulding the body. This is done by bending a piece of tin around the front and sides of the cast (with the wax articulating model on it) to get the correct curve. The tin is then removed one-fourth of an inch from the cast in front and at the sides, and is sustained in this position until freshly-mixed plaster is poured into the space between the cast and tin. This wall is then



trimmed; after the removal of the wax the wall should be lined with tin-foil.

The parts are then thoroughly cleansed for moulding. The lead plate and inside of the wall should be oiled and a piece of body laid on the lead plate before the wall is put in place. This is worked over the edge of the gum to the limit of the plate line. The wall is then put in place and the body packed up against it. The rest of the body is pressed down against the surface of the lead plate, extending back as far as the plate is to be carried. The body is then dried sufficiently to be carved into shape. This is done roughly on the cast, and when reduced to the proper thickness it is dried and biscuit-baked. When the case is cool, the enamel is applied and the final carving and gumming completed. It is then dried, placed in the muffle and burned until fully glazed. When cool, it is ground to fit the original cast, which was left unenlarged. ("American System of Dentistry.")

**What combination of metals makes a good clasp for a continuous gum partial case?**

Platinum and iridium.

**Give the formula of platinum solder.**

Gold.....	95 parts.
Platinum.....	5 "

**Mention the carat and gauge of plate most desirable for crowns.**

22-carat and 30-gauge.

**What effect on the shade of teeth has (a) platinum, (b) gold backing?**

(a) Platinum gives a bluish, (b) gold a yellowish tint.

**State the precautions that should be taken in backing a porcelain facing to prevent checking during soldering.**

The pins should not be bent close to the tooth.

The pin-holes in the backing should be so placed that the metal can be adjusted without using force.

The backing should be in perfect contact with the porcelain so as to protect it from borax.

**Upon what conditions does successful soldering depend?**

Upon the cleanliness and the contact of the two surfaces to be united; upon a good solder, and sufficient and proper distribution of heat.

**What causes porcelain facings to check and crack in soldering?**

Borax on the porcelain and the too sudden heating and cooling of the case.

**State the cause of pits in soldering.**

The use of too little borax or borax contaminated with sand or grit, or keeping the solder too long under insufficient heat, causing it to oxidize. (Dr. Wm. H. Trueman.)

**In soldering a small piece of gold to a larger piece, on which should the solder be placed? Why?**

The solder should be placed on the larger piece, the larger being harder to heat, the flow of the solder is easier directed towards the smaller piece.

**State which, in your opinion, is the best artificial crown for any of the six upper anterior teeth. Give reasons.**

Where the bite is close, a banded or partially banded crown, such as the Richmond, Litch or banded Logan crown, is most serviceable. Crowns of this style are best adapted to the root, possess greater strength and protect the root from fracture.

**Describe the method of constructing a banded Logan cuspid crown.**

A cap is made and adjusted to the root; it is then perforated to permit the dowel of the crown to pass into the root. The crown is ground to fit the labial portion of the cap, while the lingual portion may extend one-sixteenth of an inch from the cap to permit of the solder. The crown is

then removed and a piece of pure gold or platinum, 33 gauge, burnished to the base of the crown. It is then placed in position on the root and the tooth and cap united with hard wax, after which it is removed, invested and soldered.

**Give method of preparing a root for a Richmond crown.**

The root is trimmed to within a sixteenth of an inch of the gum line, except the labial portion which is cut slightly below the gum margin. The ridge of enamel remaining upon the root is thoroughly removed by means of cleavers, and with a fine disk the sides of the root are made smooth and parallel. With a root reamer or fissure drill the canal is enlarged for the reception of the dowel.

**Describe a Richmond crown.**

The Richmond crown consists of a gold ferrule with a soldered base, through the center of which a pin is attached by means of solder. To the cap thus made, a facing backed with gold or platinum is soldered. The palatal surface of the crown corresponds in shape to that of the natural crown.

**In soldering a Richmond crown, how may the solder be drawn to the front so that a perfect joint between the porcelain and the gold may be obtained?**

Liquid borax is run over the labial joint and covered with a layer of melted wax. After the case is invested and the wax removed, the joint from the inside is boraxed. In soldering the heat should be applied from the under surface of the investment, and when sufficiently hot the solder is applied and made to flow through to the labial edge.

**Give a method of removing a Richmond crown in order to repair the broken porcelain.**

If the crown is set with gutta-percha, it can be removed by applying heat to the palatal surface. If set with cement, the band on the posterior surface is cut and forced away from the root. With a rose-head bur the cement between the cap and the root is removed. A strong instrument with the

point bent at right angles is inserted and the crown forced out. It is sometimes necessary to cut the pin.

**How would you repair a Richmond crown with a broken facing?**

The remains of the porcelain are removed, also the backing. A facing is prepared, backed and adjusted with hard wax, after which it is invested and soldered.

**Describe the Bonwill crown and the method of its attachment to the root.**

It is an all-porcelain crown with an opening through the center for the passage of the supporting post. The base is concave and the upper portion of the opening is shaped to form a dovetail, which, when the crown is fixed upon its post, prevents its displacement. The edges of the porcelain are designed to rest uniformly upon the outer edge of the prepared root-surface.

The method of its attachment consists in trimming the root-face as for the reception of any post crown. By means of a corundum-stone the crown is accurately adapted to the edges of the root and made to occlude properly with the antagonizing teeth. The root-canal is reamed so as to receive a large-sized pin and with a small wheel bur it is grooved similar to a screw-thread. With a corundum-wheel the porcelain on the base of the crown, except the edges that have been adapted to the root, is removed sufficient to admit of a thicker layer of amalgam than when the crown is in close contact with the root.

Zinc phosphate is then mixed and carried to the end of the root-canal and the post pressed into it. The crown is now placed over the tin and into its proper position; it is allowed to remain until the cement is hard, when it is removed and amalgam packed into the canal and about the pin. The concavity in the base of the crown is also packed with amalgam and the crown firmly pressed into position by means of a crown-driver, devised for that purpose. A fresh mix of amal-

gam is packed about the pin in the cavity on the occlusal surface, which when hard, is dressed and polished.

**Describe the method of constructing a porcelain-faced bicuspid crown.**

A shell crown is made and fitted to the root. The buccal portion is cut out, leaving the band intact at the gum margin to the depth of a sixteenth of an inch. A cross-pin facing is ground to fit the opening, backed with 33-gauge pure gold, and readjusted to the crown. The crown and facing are held together with binding wire wrapped directly over the facing, which should be protected from discoloration with asbestos fibre. Flux is added and the crown soldered by holding it over the flame of a Bunsen burner.

**Describe a method of constructing a bicuspid jacket crown with a porcelain facing fused to it.**

A ferrule is made of platinum plate of 30 gauge. This is fitted to the tooth. It is then trimmed to be even with the tooth crown. A piece of iridio-platinum plate is soldered to the band, allowing the buccal half to be free. Pure gold should be used for solder. The face of the cap is then cut out; the portion of the top plate which is free is shaped to form a cusp. A facing of the proper shade and size is ground to fit the opening. The porcelain is now mixed and packed into the spaces and against the metal to which the facing is to be fused. The facing is then pressed into place, the case carefully dried and the porcelain fused. If more body is required, it can be added and the case re-fused.

**State the method of adding a low-fusing porcelain face to a gold shell crown.**

A seamless crown is made and fitted to the root. The portion of the surface of the crown to which the porcelain is to be added, is crushed in with a few taps from the bench hammer; it should be sufficient to admit of a thick body of porcelain. The surface is then roughened or perforated. The body is mixed, packed on to the gold, dried and baked.



This is repeated until the desired shape and size is obtained, when the crown may be polished.

**Describe a Mason detachable porcelain-faced crown. State the advantage of its use and where applicable.**

It consists of a drop-forged backing of heavy gold plate which has a triangular slot throughout its length, and a porcelain facing with a triangular bar baked in the longitudinal axis of its lingual surface; this is constructed so as to slip into the slot of the backing.

The advantage of this crown is, that in case of fracture a new facing can be adjusted without necessitating the removal of the collar and post. It is applicable on all post and collar crowns or as dummies in anterior bridges.

**What advantage, if any, have Richmond crowns over others?**

They protect the root from fracture and decay and are stronger where an unusual stress has to be borne by the root.

**Describe fully the method of preparing a molar tooth for a gold crown.**

With carborundum stones and disks, the sides of the natural crown and neck of the tooth are made parallel, or the circumference of the crown less than that of the root.

**Describe fully a method of constructing a gold cap or shell crown for a molar tooth, the cusps of which occlude accurately with the antagonizing teeth.**

The tooth properly prepared, a measurement is taken at the neck of the tooth by means of the dentimeter and annealed brass wire No. 33 gauge. The wire is cut, straightened, laid on the gold and a band cut of corresponding length and wide enough to extend from below the gum margin to within a sixteenth of an inch of the opposing tooth. The band is now annealed, the ends are beveled and united with 20-carat solder. The cylinder is trimmed and fitted to the tooth, the joint placed so as to come on the palatal aspect. It is re-



moved, contoured and re-adjusted; a small roll of softened beeswax is placed in the mouth and the bite taken including two or three of the adjoining teeth. This is removed and a plaster impression taken, in which the barrel is embedded. A model and an articulating model are made and mounted upon a crown articulator. The occluding teeth are then varnished, the barrel filled with soft plaster and the occlusion made. When the plaster is set, it is trimmed sufficient to expose the gold rim. Cusps and sulci are then carved in such a manner as to occlude properly with the antagonizing teeth. The collar and the plaster cusps are then pressed into moldine, removed, and Mellotte's metal poured into the mold. Annealed 22-carat plate 30 gauge is placed on a pine block and with the die the cusps are swaged. It is now trimmed, and adjusted to the cylinder. Both sections are pickled, the parts brought together and held in apposition with binding wire; flux is added and the parts united with 20-carat solder by holding them over the Bunsen flame. The crown is then trimmed and polished.

**How would you repair a gold cap with a hole in it?**

The crown is boiled in acid, after which the hole is filled with a large pellet of soft gold and solder flowed over.

**How would you remove a gold crown from a diseased molar tooth?**

The palatal surface of the crown is slit with either a chisel or cutter devised for that purpose, and the laps of gold pulled away from the tooth. A sharp-pointed instrument is then worked between it and the crown surface of the tooth, and with slight pressure the crown can be forced away from the tooth.

**Give details of constructing a gold cap for a cuspid.**

The measurement of the root to be crowned is taken with an annealed copper strip which is placed around the root and grasped firmly with pliers. The strip is removed, the surplus ends trimmed and the band cut through the center. The re-

spective halves are bent over the lingual and labial forms of a Holingsworth mould-plate. When the proper form is selected, it is placed on the moulding plate with a rubber ring around it; into this is poured Mellotte's metal and a die of the two surfaces secured. Annealed 22-carat, 30-gauge gold is placed over the die and the sections swaged separately. They are now boiled in acid, the edge smoothed and trimmed, the parts brought together and held with binding wire. Flux is applied and the halves united with 20-carat solder.

**Describe the method of constructing a bicuspid crown with a porcelain front for a tooth having a vital pulp.**

The tooth is trimmed for the reception of the collar. Sufficient of the buccal surface of the tooth is removed to accommodate the porcelain, care being taken not to injure the pulp. A seamless gold crown is then made and fitted on the tooth; the buccal surface is cut out, leaving intact a sixteenth of an inch, the portion extending above the gum line. No. 60 gold-foil is burnished on the tooth and, while in place, the crown is adjusted; through the opening cut for the facing a small nodule of soft beeswax is forced. The crown with the wax and gold-foil is removed and invested in a mixture of silex and plaster. The case is then dried, the wax thoroughly removed and low-fusing body packed into the space occupied by the wax and over the face of the crown. This is baked, after which sufficient porcelain is added to give the desired shape and size. It is again baked and the crown polished.

**What style of a crown would you use to restore abraded front teeth?**

A barrel crown of either gold or platinum with a veneer soldered or fused to it.

**Describe the Davis crown. State how you would adjust it to the root.**

The Davis crown consists of two parts: The pin, which is separate from the crown, and the crown itself. The crown is all-porcelain with an opening extending well into the body

for the reception of the pin. In adjusting it, the edges of the crown are ground to fit the face of the root accurately. The root canal is reamed to receive the pin, which is cemented into the canal. The cavity in the crown is then filled with cement and the crown placed over the pin is forced into position.

**What is the advantage of the Davis crown?**

In case of fracture a new crown can be adjusted without removing the dowel.

**Describe the process of making a molar crown with a gold band and a saddle-back or plain rubber tooth.**

A ferrule is made as for an all-gold crown. A bite and impression are taken and the models mounted upon a crown articulator. A wire measurement is then taken of the circumference of the upper portion of the ferrule. A tooth is selected, the circumference of which is the same as that of the ferrule. The buccal face of the ferrule is cut out, except the slight rim of gold extending beneath the gum. By means of corundum-wheels the edges of the porcelain are made to fit the edges of the gold at the cervical and approximal borders, care being taken to have the articulation perfect. Pure gold No. 35 gauge is burnished to the under-surface of the porcelain; it is now adjusted to the barrel, invested and soldered.

**Describe a method of making and attaching a swaged shell corner for a central incisor, the cavity of which involves both labial and lingual wall and the masticating surface.**

The tooth is thoroughly excavated; the enamel edges beveled and smoothed. A small piece of softened modeling compound is pressed into the cavity and allowed to harden, when it is removed and with a sharp-bladed instrument trimmed and carved to correspond to the desired shape of the corner. It is then pressed into "moldine" and a die of Mellotte's metal made. Annealed 24-carat gold 30 gauge is

swaged; the edges are trimmed and made to slightly overlap the cavity margins. The shell is re-inforced with 20-carat solder, to which two pins, made to extend well into the cavity, are soldered. The corner is now polished and adjusted by first filling the cavity, then the shell with cement; it is now placed in position and held until the cement is hard. That which oozes out is removed and the margins coated with varnish.

**Describe the method of preparing a root for the reception of a Büttner crown.**

A special set of instruments is required for this process: drill, root-facer and trephine. The root-facer, guided by a central pin, cuts the face of the root level. The drill is used to open and enlarge the canal, and by means of the trephine the neck of the root is made cylindrical.

**Describe the method of preparing and attaching a porcelain tip (lower third) to a central incisor with a vital pulp.**

The surface of the tooth is made smooth and square. To this is burnished a piece of platinum plate No. 35. With the plate in position on the tooth, three holes are drilled as deep as may be done without injuring the pulp; in each of the openings a post is placed and adhesive wax flowed over the projecting ends, attaching them to the plate. The plate is then carefully removed, invested, and the pins united to the plate with pure gold. The piece is placed on the root, the pins trimmed to within a thirty-second of an inch of the plate, care being taken to have the plate well burnished. A plaster impression is taken and removed with the small plate embedded in it. A model is made with sand and plaster, which when hard, is carefully removed from the impression. A cross pin tooth of the desired shape and size and with the pins close to the cutting edge is selected. The facing is then cut down to about the desired length and the final fitting to the tooth made with a fine grit stone. It is then backed with

platinum No. 28, attached to the plate with sticky wax and invested in sand and plaster. When dried, the case is soldered with 22-carat solder. In setting it, the rubber dam is adjusted to the tooth, the holes in the tooth are filled with soft cement and the tip is placed in position; it should be held firm until the cement is hard.

**What are the requisites of a crown?**

It must protect the root from decay and should restore the appearance and the function of the natural tooth.

**In bridge-work should the teeth fit the gum perfectly or should a space be left between the gum and the bridge? Explain.**

A space should be left between the gum and the teeth in order to facilitate cleansing.

**Describe the construction of a bridge to replace the inferior central incisors, the remaining teeth being sound and in place.**

With disks and corundum-wheels the lateral incisors are prepared for the reception of open-face crowns which are made of 22-carat gold, 29 gauge. The crowns are adjusted to the teeth, and a wax bite and a plaster impression are taken with the crowns in place; when the impression is removed, the crowns, if not imbedded in the plaster, should be placed in their respective position in the impression. The model is run with plaster and marble dust and with the articulating model it is mounted on the crown articulator. Facings of the desired shape and size are selected, backed and adjusted to the cast with hard wax. The case is now invested, dried and heated, the borax applied and the case soldered.

**Describe a method of constructing a gold bridge to replace lost teeth between the cuspid and second molar, both named teeth being in place and sound.**

The cuspid tooth is devitalized, the pulp extirpated and the natural crown cut off. The root is then prepared for the re-



ception of a collar crown which is made and adjusted. The molar tooth is prepared and a shell crown made of 22-carat gold, 29 gauge. This is placed in position and a wax bite taken of the entire side. An impression of the antagonizing teeth is taken in wax and the model poured. A plaster impression is now taken with the crowns in position which should be imbedded in the plaster when the impression is removed. A model is then run and with the articulating model it is mounted on the articulator. The bicuspid and the molar facings are selected and ground to fit the model, the upper edge extending to within a few lines of the gum.

The occluding edge of the facing—ground to within a sixteenth of an inch of contact with the opposing teeth—is beveled toward the outer edge.

Backings are fitted to the facings, extending from the cutting edge to near the gum line. Cusps for the respective teeth are then swaged on a die-plate and fitted to the facings. They are united with hard wax, invested and soldered separately with 20-carat solder, using sufficient to give the proper shape. When cool, they are boiled in acid and mounted on the cast, to which they are attached with hard wax. The bridge is now carefully removed from the articulator and embedded in an investment of plaster and asbestos fibre; it is dried, heated in the furnace, boraxed and soldered. When cold, it is removed from the investment, boiled in the acid, trimmed and polished.

**State the method of making the grinding surface of a bridge with one continuous piece of gold.**

The abutment crowns in place, a bite and plaster impression are taken and the models mounted on the articulator. Suitable facings are selected and fitted to the cast. The cutting edges are shortened sufficient to permit of a protecting covering of gold. The backings are adapted, the facings invested and solder flowed over the backings, having the pins well covered with the solder. They are now trimmed, adjusted to the cast and a roll of softened beeswax is placed



between the abutments and extended over the cutting edge of the facings. The cusps of the antagonizing teeth are oiled, as is also the surface of the wax, which is again warmed and the jaws of the articulator brought together. When separated, the cusps and sulci are carved to occlude accurately with the antagonizing teeth. The wax cusps are then removed from the model and embedded in a mixture of plaster. A rim of thin copper about an inch in width is placed around the wax and in the soft plaster. When the plaster is hard, it is placed over a burner and gradually heated until the wax is soft enough to be removed. When the mould is thoroughly dried, it is run with Mellotte's metal. On the die thus secured a strip of annealed gold 22-carat 30 gauge is swaged. This is boiled in acid, the edges trimmed and the cusps re-inforced with 20-carat solder. It is then placed on the model and the facings adjusted to their proper position. The case is now invested and soldered in the usual way.

**Give a method of making and attaching a removable bridge.**

The abutments are properly prepared and collars with flat tops are made and cemented in place. Telescoping caps are then constructed and fitted over the barrel-covered abutments. A bite and an impression are taken, the caps being embedded in the impression. Models are made and mounted on the articulator. The dummies are made and soldered to the caps. The bridge is then trimmed and polished. The caps are warmed, lined with a film of gutta-percha, placed in position over the barrel-covered abutments and the bridge forced into place.

**If a bridge, extending from the canine to the third molar, breaks in the middle, what is the method of repairing it?**

The bridge is removed, boiled in acid and re-adjusted in the mouth. By means of a plaster matrix it is removed, invested and soldered.

**How should the loss of a superior lateral incisor be supplied?**

An impression, including the adjoining teeth, is taken and a die made. Gold plate, 22-carat, 29 gauge is swaged to the palatal surface of the cuspid and central incisor. Holes are drilled in the palatal surface of each tooth extending into the dentin, care being taken not to encroach upon the pulp; the openings should be well undercut and large enough to accommodate a flat-headed platinum pin. The plates are then placed in position, a hole corresponding to the one in the tooth is drilled and the pin inserted and united to the plate with sticky wax. The plates are removed, invested and soldered with 22-carat solder. They are then adjusted to the teeth and held with a little soft gutta-percha. A plaster impression is taken with the plates in position; when removed, the plates are placed in position in the impression and the model run in plaster and marble dust. A facing is selected, backed and fitted to the model, it is attached to the backings with hard wax. The case is then invested and soldered.

**Describe a method of constructing a bridge extending from a lower first bicuspid to a third molar, both teeth inclining towards each other.**

Abutment caps are constructed with square tubes soldered to the distal surface of the bicuspid and mesial surface of the molar. A bar, extending across the space, is bent so that the ends will slip into the tubes. The abutments are placed on the teeth and a bite and plaster impression taken. The crowns are then placed in their position in the impression and the models made and mounted. The bar is now adjusted to its place and plain rubber teeth waxed to the bar. The teeth and bar are removed from the cast, the case is flaked, packed and vulcanized. The crowns are cemented in place and the bar, with the teeth vulcanized to it, is slipped into position.

**What is the object of an investment?**

The protection of the porcelain from the flame, to afford

attachment, and to support in proper position the parts to be soldered.

**What is the best investment for crown and bridge work?**

A combination of fibre asbestos and plaster of Paris.

**Why is silver not used in crown and bridge work?**

Because it is soon corroded by the oral secretion.

**How may a badly decayed root be re-inforced or strengthened sufficiently to carry a dowel or pin crown?**

The decay should be removed and the tooth thoroughly sterilized with nitrate of silver. Small grooves are cut with a wheel-bur in the root canal, which has been well reamed. The canal is then packed with amalgam, and while soft a steel pin is forced well up in the center. More amalgam is added and banked up around the pin. The amalgam is then held firmly with the fingers of one hand, while the pin is carefully removed with the other.

**Give method of taking an impression of a root for a gold crown.**

An annealed copper band is shaped and placed on the root; while in position, an impression is taken with plaster in a small tray.

**State the difference in degrees between the boiling-point of water and the fusing-point of gold.**

About 1804 degrees.

**Describe Brown's porcelain bridge, stating advantages and disadvantages.**

It consists of a rigid supporting and anchoring bar to which are adjusted porcelain teeth, attached to the bar by means of porcelain fused about the parts.

The advantages claimed for it are: that it is less liable to fracture than facings employed in the regular bridge; its natural appearances and cleanliness. Its disadvantage is, that in many cases its application necessitates the mutilation of sound teeth.

**How would you secure an anchoring bar to a vital tooth?**

By means of a filling of cohesive gold, which should be inserted with the electric mallet. In the posterior teeth amalgam can be used for the same purpose.

**State the method of preparing and filling a cavity in a porcelain tooth.**

The cavity is prepared by means of a diamond-pointed drill. The tooth is placed in plaster to facilitate holding it during the process of filling, which is done in the usual way.

**At what age is the regulating of the teeth permissible?**

At about the ninth year, or as soon as appliances can be used to advantage.

**State the principle of Farrar's system of regulating.**

The moving of teeth should be by force that is positive in character.

**Describe Dr. Farrar's appliance for moving roots forward.**

"The base of support is a transpalatal screw-jack, anchored by two clamp bands that embrace the side teeth; from this jack to the posterior sides of the necks of the incisors are two other screw-jacks to press against these front teeth. To hold these jacks upon them, a broad band with a U-shaped lug soldered on the lingual side is cemented to each incisor in which a bar connecting the anterior ends of the jack rests. To hold firmly the end of the crown of each incisor, and to prevent them from moving forward when the jacks are set at work against the necks of the teeth, the ends are tied to the transpalatal jack by two wire cords connected with a cross bar lodged in other U-shaped lugs soldered to the labial side of the bands." (The American Text-Book of Operative Dentistry.)

**Describe Dr. Farrar's appliance for moving roots back.**

"The crowns are stayed by an inside rectangular frame resting in U-shaped lugs at the ends of the crowns and braced

against nuts soldered to two anchor clamp-bands on the side teeth. The roots are drawn back by a labial bow, attached to the clamp-bands by screws.”

**Describe the Jackson crib and base wire.**

It consists of a base wire, No. 13 or 14 B. & S. gauge, connecting cribs placed on the two opposite molars or bicuspid, and bent in a bow corresponding to the lingual surfaces of the teeth. To this base wire are soldered springs for moving teeth in different directions according to the requirements of the case.

**State a method of rotating a lateral incisor.**

It can be rotated by means of piano wire soldered to a band which is cemented to the lateral incisor, the free end of the wire held by a lug on the second bicuspid band.

**Describe the Angle method of retracting a protruding lower jaw.**

A large traction screw is attached to clamp-bands which encircle the first lower molars. The ends of the bar are hooked into small staples soldered to the distal angles of bands upon the canines; while a piece of gold wire attached by solder connects these bands and passes in front of the incisors. This appliance is used in conjunction with a metal cup swaged to fit the chin and connected by rubber bands with a cap on the back of the head.

**Describe a method of bringing into proper position a right upper cuspid that bites inside the circle of the lower teeth.**

A jack-screw extending from the palatal surface of the first bicuspid to the palatal surface of the cuspid is adjusted. By turning the screw a little each day the cuspid will be forced into position.

**Describe Angle's appliance for retracting a cuspid.**

Angle's drag-screw consists of a stiff wire, screw-cut at one end and bent into a hook at the other. Anchorage is secured



by soldering a tube to a molar and a bicuspid band. The serew-cut end is passed through the tube and the nut placed in position. The end with the hook is slipped into a tube soldered to a band which is cemented on the cuspid.

**Give a method of elongating bicuspids when they fail to occlude properly.**

Bands to which hooks are soldered are cemented to the upper and lower bicuspid teeth. A rubber band is stretched from the hooks on the upper bicuspids to the corresponding ones on the lower bands.

**Describe Dr. Case's appliance for raising the occlusion of the lower bicuspids.**

On each bicuspid is cemented a band with a buccal hook pointing downward. On the band for the molars is soldered a hollow tube. On the incisors are cemented bands with hooks turned upward. A labial bow of piano wire with the ends inserted in the tubes on the molars' bands, the front resting above the hooks on the incisors and the sides pressed under the hooks on the bicuspids.

**Describe Case's retainer for the anterior teeth.**

It consists of a series of bands soldered together at their point of contact with an excess of solder in front. The labial surface of all but the end bands are cut away, so as to leave only a small portion between the teeth; these are filed so as to resemble gold fillings. The appliance is stiffened by soldering a piece of swaged plate to the lingual surface.

**Describe a simple retainer for a single tooth that has been rotated.**

A wire is soldered to the labial surface of a band which is cemented to the tooth. The wire should project so as to rest on the labial surface of the adjoining teeth.

**Describe an appliance for expanding or enlarging the arch**

Wide bands are made for the first bicuspid and first molar



of each side. The bands on each side are joined by a bar soldered to the lingual surface. This bar is made of clasp gold of No. 22 gauge and should be about one-eighth of an inch wide; in this holes are punched at short intervals. Angle's jack-screw is then adjusted, placing the pointed end of the tube in a hole in the bar on one side, and one prong of the forked end in a hole in the opposite bar. The force is applied by turning the nut.

**Give the method of obtaining an impression of a perforated hard palate.**

With quick-setting plaster the cavity above the roof of the mouth is filled even with the border of the fissure, and while soft, the palatal impression is taken and retained in position until the plaster is hard. The palatal surface of the plaster above the roof of the mouth should be coated with a solution of soap to prevent the two masses from adhering when brought in contact. The impression of the palate is removed in the usual way and with a pair of pliers the mass from the nasal portion is carried backward and withdrawn from the mouth. The two portions are then placed together and waxed.

**Give the method of taking an impression of a cleft palate.**

An impression tray of the proper size is selected; it should extend slightly beyond the posterior borders of the hard palate. It is sometimes necessary to lengthen the tray by means of a flap of base-plate gutta-percha, which may be carried back as far as the uvula. Plaster of Paris mixed in the usual way is placed in the tray, care being taken not to use too much. The tray is introduced into the mouth and pressed up quickly and firmly, holding it in place until the plaster will break with a clear fracture, when it is removed.

**What is an obturator?**

It is an appliance employed to close an opening in the hard or soft palate.

**Define an artificial velum.**

It is an appliance made to supply the loss of the posterior soft palate.

**Describe the method of constructing an obturator.**

A model having been obtained, the fissure in the hard palate is filled with wax. Dies are made and a gold plate swaged to fit the reconstructed model. The plate is provided with an extension at the posterior extremity which is to support the obturator and is attached to the teeth by clasping the six-year molars. The plate is then fitted to the mouth and a loop of copper wire soldered (with soft solder) to the upper side of the plate and extended backwards about two-thirds of the length of the fissure. A mass of softened beeswax is wrapped about the wire loop and shaped to correspond to the fissure. It is then slightly softened in warm water and placed in the mouth; the patient is directed to swallow several times; by this means the softened mass is moulded to the required shape. When removed from the mouth, the palatal surface is trimmed into a continuous flat surface; the upper surface is treated similarly. In the region of the uvula the sides must be trimmed away so that they may close under the obturator. Plaster is then mixed and a little placed upon the upper side of the plate, extending from the wax bulb forward to reach the end of the fissure when placed in the mouth. The plate with plaster upon it is then introduced in the mouth and carried into place. By this means an impression of the forward part of the cleft is obtained. Plaster moulds are now made and the case flaked. Before packing, patterns of the upper and under surfaces of the bulb are cut from No. 60 tin-foil, and a single pattern to extend around the sides and end. These are reproduced from sheet rubber and are united to form the bulb by placing the edges tight together. Before finally closing, water should be introduced, filling the bulb about half full, care being taken that the edges of the rubber do not become wet. The flask is closed

and the case vulcanized. The bulb is then fitted to the plate. A hole is drilled through the bulb and plate, through which an iridio-platinum bar is passed and soldered to the plate, the opposite end being screw-cut and supplied with a nut. The surface of the plate, on which the bulb is to lie, is smeared with gutta-percha, the bulb slipped over the bar, and the nut screwed down until it impinges. The plate is then warmed over a burner, the gutta-percha softened and the nut screwed tight. The plate and bulb are trimmed and polished.

**Describe the method and material you would use to secure a perfect impression of the inferior maxilla when fractured.**

Plaster of Paris is prepared and placed upon the oiled surface of a large impression tray. The fragments of the jaw should be held in position by an assistant and the tray introduced and carefully pressed into place. When the plaster is hardened, the tray is detached and by means of a sharp instrument the impression is cut and removed in sections. The pieces are replaced on the tray and held together with wax.

**Describe the method of constructing an interdental splint.**

The model of both jaws being obtained, they are carefully articulated by cutting with a small saw the lower cast at the point of fracture. The sections are re-arranged so as to bring the teeth of the two models into proper articulation. They are then secured with plaster and the two models mounted on the articulator. The interdental dovetail spaces are filled with soft plaster.

The bite is opened about half an inch by means of the set-screw in the articulator. The teeth and a portion of the gums of both casts are covered with No. 60 tin-foil. A layer of rubber is then cut so as to completely cover the foil, one for the upper and one for the lower cast. The rubber is warmed and with a hot instrument it is adapted and fastened

to the cast. The articulator with the casts is then brought into proper position and united with rubber posts placed in the position of the cuspids and molars. With a hot spatula the surface of the rubber is made smooth and the edges fastened to the plaster. The case is now ready for flasking. Soft plaster is run into the interior of the moulds which are then embedded in a large flask containing soft plaster. The case is vulcanized and finished in the usual manner.

**State the relative merits of gutta-percha and cement as a retentive medium for crowns and bridges.**

The adhesive properties, as well as the hardness, of oxy-phosphate render it valuable in such cases as require rigidity and support.

Gutta-percha is valuable in cases where removal may be desirable and where the retentive medium is exposed to the fluids of the mouth.

**Describe the Bonwill articulator.**

It is composed of brass wire and tubing, and consists of a base and a pair of bows. The upper bow is narrower than the lower bow; they are detachable by loosening the set-screws. At either extremity of the cross-bar is an eyelet, through which the "condyle" of the articulator works. Back of the condyle are two spiral springs which represent the muscles. This construction permits the side motions of the lower jaw to be fairly well imitated.

**State the method of facing a black rubber plate with pink rubber by vulcanizing once.**

The preparatory steps for flasking and packing are the same as for the ordinary case. Strips of pink rubber are placed between the teeth, and extending from above the pins to the top of the rim. A layer of pink rubber, the exact size and shape of the palatal portion of the plate, is cut and placed in position, care being taken to have no spaces or crevices. A sheet of black rubber is stretched to one-half its regular thickness. It is cut to the desired shape and size

and placed in position over the pink; the edges should be neatly packed about the pins. A piece of holland is placed over the rubber, the flask closed, heated, and the bolts tightened. The flask is then opened, the cloth removed, and a narrow rim or roll of black rubber, extending from heel to heel of the plate, is placed at the junction of the black and pink rubber. The flask is closed and the case vulcanized.

**Describe the method of reproducing the rugæ in a vulcanite plate. State the advantage.**

Heavy tin-foil is swaged or burnished upon the palatal portion of a model having well-defined rugæ. The tin-foil is carefully removed and the lines of the rugæ neatly filled with yellow beeswax. The tin-foil is then fitted to the palatal portion of the denture while it is in the lower section of the flask and before the upper section has been filled with plaster. The beeswax in the lines of the rugæ prevent their being crushed while the tin-foil is being made to conform to the palatal surface of the denture. When this has been adjusted, the flasking is completed and the case finished. The tin-foil imparts to the vulcanite a polished surface, and no smoothing is needed on this portion of the plate.

The advantages of the rugæ on the vulcanite plate are: the tendency to lisp is greatly lessened, it has a more natural feeling to the tongue, and pronunciation is assisted.

**How may the extreme limit of the posterior border of an upper plate be determined?**

By the degree of sensitiveness of the tissues to the plate. The posterior border should not encroach upon the soft palate nor should it cause discomfort to the patient.

**How would you repair a broken clasp on a rubber plate?**

A new clasp should be made and attached to the plate by vulcanizing.

**What are the uses of silex in dentistry?**

To prevent the adhesion of plaster to, and to produce a



smooth surface on vulcanite. It is used also to unite portions of a broken plaster model.

**Describe the blowpipe invented by Dr. J. Rollo Knapp and state some of its uses.**

It consists of blowpipe attachments connected with a nitrous oxide gas cylinder, the cylinder being set upright and attached to an iron base, at the other end of which is a movable table upon which to rest the work. The blowpipe proper is a continuation of the outlet tube of the gas cylinder. A lever-valve regulates the supply of nitrous oxide. Beyond this valve is the mixing chamber, to which illuminating gas is conducted from the gas-pipe through a rubber tubing entering the bottom of the chamber. The mixing chamber is provided with a gauze screen to prevent the flame from being drawn into the tubes. Beyond the mixing chamber a pipe is branched so as to afford two flames of different sizes. It is practically an oxy-hydrogen blowpipe. It may be used to melt small quantities of platinum, but it is especially useful in crown and bridge-work manipulations, where an extremely high temperature is required to fuse metals so quickly that the heat will not extend beyond where it is required.

**Describe the treatment of prognathism.**

The treatment consists in forcing back the body of the lower jaw into a more posterior position in its relations to the upper, partly by bending the rami and necks of the condyles and partly by absorption of the posterior wall of the glenoid fossa. This is accomplished by means of caps fitted to the head and chin, united so as to exert a uniform pressure on the surfaces upon which they rest.

**Describe the Norton-Talbot spring and give the method of using it in expanding the arch.**

It is a spring of piano wire, Nos. 20-24, B. & S. gauge, coiled upon itself one or more times.

It is applied by fitting the ends of the spring into holes



made in a bar connecting the bands on the lingual surfaces of the teeth.

**Describe the Matteson lingual bow and give method of attachment for moving the upper central incisors forward.**

It consists of molar and bicuspid bands joined by a strip on the buccal surface and a piece of metal tubing closed at one end on the palatal surface. A piano wire is inserted in the tube and the free end allowed to press on the teeth to be moved. The end is held in position by means of a tag united to the band, which is cemented on the tooth.

**Describe a labial bow and hook-band and its application for rotating a lateral incisor.**

It consists of bicuspid bands, one for each side, with tubes soldered on the buccal surface of each. Into these tubes the ends of the labial bow are inserted. A band with a hook soldered on the lingual surface is cemented to the lateral incisor. A rubber band is caught over the hook and attached to the bar.

**Describe an occipital appliance and yoke used for re-tracing and shortening the upper central incisors.**

It consists of a frame of gold fitting to the cutting edge of the incisors and lapping on to the canines. To this is soldered a stud or post a half-inch in length extending out of each corner of the mouth. The ends are bent in the form of a hook, and are made to extend far enough from the cheek to permit of rubber bands or ligatures extending to a skull-cap without impinging on the cheeks. The occipital cap is made of two pieces of silesia with dress-hooks sowed at each side to afford attachment to the ligatures.

**Describe the Magill band and its methods of attachment.**

It consists of a strip of metal Nos. 30-36 gauge and about one-eighth of an inch in width. This is bent around the tooth and soldered at the overlapping ends. It is held in position by means of zinc phosphate cement.

**State the six directions in which the various teeth may be moved in adjusting irregularities.**

Forward, backward, inward, outward, upward, downward.

**Differentiate the terms occlusion and articulation.**

The occlusion of the teeth is the relative position of the upper and lower teeth as they naturally close together, with the cusps of the teeth of one arch resting in the sulci of those of the opposite arch.

Articulation implies the relation of the lower teeth to the upper in the several movements of the mandible during the act of mastication.

**Describe a simple but accurate method of securing a profile record of the face in regulating cases.**

A piece of soft lead wire about one-eighth of an inch in diameter is shaped with the fingers to the contour of the features at the median line from the forehead to the chin. It should not be permitted to press unequally on any part. The wire is then placed on a strong cardboard, care taken to prevent its bending. With a fine-pointed pencil the outline of the wire is traced on the cardboard; this is then cut according to the penciled line. The card will fit to the profile of the features.

**Describe a facial goniometer and explain its use.**

It is composed of a semicircle to which two arms of steel are attached. One of these has no movement of rotation but moves horizontally on the pins, its upper edge always remaining at zero. The other is movable on the pin and can be made to assume any angle with the horizontal arm; one of its edges is beveled to facilitate reading the angles. The arms can be lengthened or shortened at will.

It is used for measuring facial angles.

**Describe the Justi removable-pin crown.**

It consists of a porcelain crown and a detachable pin. The crown has a ridge which extends the entire length of the lin-

gual side of the opening or recess into which the pin fits. On the labial side are three deep grooves or undercuts. The opening is horshshoe-shaped, and contains also a cup-shaped depression at the neck. The pin is flattened on the lingual side; it is deeply serrated and has a slot or groove at the base which fits over the ridge in the crown.

**State some of the changes in position, form, and color of the teeth that occur in a natural denture with advancing years.**

There is a tendency for the teeth to move forward and to elongate; also a wearing down from abrasion. The teeth darken in color, assuming, generally, a deep yellowish hue.

**Describe the Griswold retainer for artificial dentures.**

It consists of a V-shaped tube, corrugated, called the "spring"; this is soldered to a crown. A counter part is made to fit over it with corresponding corrugations called the "box." The box is located in the denture. The corrugations on the spring and those on the box interlock and form a distinct locking device which holds the denture firmly in place.

**Of what value is kaolin in porcelain bodies?**

It gives plasticity and imparts strength.

**Mention the material that is used as flux for reducing the fusing-point of porcelain enamels.**

Flux (glass); a composition of powdered silica, glass of borax and potassium carbonate.

**What frit is used to produce porcelain-gum enamel?**

Purple of cassia, feldspar, quartz, glass of borax, and carbonate of potassium.

**Give the composition of spelter solder sometimes used in the preparation of gold solder for the purpose of reducing the fusing-point.**

It is an alloy of copper and zinc, containing more zinc so

as to make it more fusible than the alloy of zinc known as brass.

**What special quality has borax which makes it such an admirable flux in soldering and melting metals?**

At a high temperature the salt fuses and becomes glass, in which state it possesses the property of dissolving metallic oxides.

**Give a formula for a 20-carat gold clasp metal.**

Pure gold .....	20
Silver.....	2
Copper.....	1
Platinum.....	1

## ORAL SURGERY.

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**What conditions are necessary to obtain bony consolidation after fracture?**

Accurate apposition of the fractured surfaces without the interposition of pieces of muscle, connective tissue or an excessive amount of blood-clot, immobilization for a sufficient length of time, sufficient blood supply to both fragments, sufficient innervation, absence of surface inflammation and constitutional causes of non-union. Asepsis is greatly to be desired, but bony union can occur in suppurating wounds by a process analogous to the healing of wounds by second intention.

**In what stage of inflammation is cold a valuable remedial agent? Give reasons.**

Cold is a valuable remedial agent in the beginning of inflammation since it causes a contraction of the blood-vessels, and therefore lessens the amount of blood in the part. When permanently employed it dilates the vessels by paralysis of the muscular coat and the increased amount of blood brings to the part an increased quantity of leucocytes and protective proteids. If applied for too long a time, it lowers the vitality of the tissues, promotes stasis, and interferes with the ameboid action of the leucocytes.

**At what age are the best results obtained from operations for cleft palate? Give reasons.**

The best results are obtained by operating between the second and third years. It is not advisable to operate upon infants, since they stand hemorrhage poorly, suck the stitches and disturb them with the tongue, and because the tissues

are delicate and friable. It should not be deferred later than the period indicated, as bad habits of articulation will be contracted and subsequent success, as gauged by the quality of the speech, is much less likely to follow.

**Differentiate lacerated and contused wounds.**

A lacerated wound is a wound produced by a tearing of the tissues.

A contused wound is a wound produced by a bruising of the tissues.

In practice the distinction is not well drawn, since the edges of most lacerated wounds are also more or less contused.

**State the predisposing causes of lingual carcinoma.**

Age of the patient (past 40); any irritation, such as a sharp tooth, the stem of a pipe, or a badly fitting plate; psoriasis and scars produced by syphilis or injury; smoking.

**What are wounds and how are they classified?**

A wound is a solution of continuity of an external or internal surface of the body.

Wounds are classified as follows: Incised, lacerated, contused, punctured, poisoned and gunshot.

**Give varieties of fracture of the inferior maxilla.**

Through the body of the bone in the neighborhood of the mental foramen, at the angle or within the vertical ramus, through the neck of the condyle, and at the base of the coronoid process.

**Describe the operation for ligating the facial artery.**

After all aseptic precautions have been carried out, a horizontal incision, one inch in length, is made directly over the vessel as it crosses the lower border of the jaw immediately in front of the masseter. The incision divides the integument, the fascia, and the platysma myoides. In making the incision, the skin should be drawn upward over the bone, so that when the skin retracts, the scar will not be visible upon



the face. The vessel is ligated just as it emerges from the substance of the submaxillary gland. The aneurism needle is passed from behind forward.

**What is anesthesia?**

Anesthesia is a condition of total or partial insensibility, particularly to touch.

**Define synovitis. Give symptoms and treatment.**

By synovitis is meant the inflammation of a synovial membrane.

Symptoms.—The joint becomes the seat of lancinating pain and is filled with fluid. If the articulation is superficial, the overlying skin may be hot and hyperemic. There is a spasm of the surrounding muscles, causing the joint to be held in that position which affords the greatest ease to the patient. In some cases the muscles controlling the joint undergo a rapid atrophy. If suppuration occurs, the overlying integument becomes dusky red and edematous. The pain becomes throbbing in character, and the individual is frequently awakened at night by starting pains in the extremity. The temperature is high and there is emaciation.

Treatment.—Immobilization. In the early stages and in young people, cold is of value (evaporating lotions, ice-bag, Leiter's tubes). Later on, warm fomentations may be used or a few leeches applied. If painful distention is present, some of the fluid may be aspirated under strict aseptic precautions. Should suppuration occur, the joint must be opened, irrigated, and a rubber drainage-tube introduced into the most dependent portion.

Any underlying diathesis should receive appropriate constitutional treatment.

**Describe the operation for ligating the temporal artery.**

Make a vertical incision one inch in length, a half inch in front of the tragus, and just above the zygomatic arch. Divide skin, superficial fascia and deep fascia, and then feel

for the pulsation of the vessel. The aneurism needle is to be passed from behind forward so as to avoid the temporal vein and the auriculo-temporal nerve.

**Give the varieties of gangrene.**

1. Symptomatic gangrene: embolic, senile, diabetic, Raynaud's disease, ergotic.
2. Traumatic gangrene: direct and indirect.
3. Infective gangrene: acute rapidly spreading gangrene, hospital gangrene, necrosis of bone, noma or cancrum oris, carbuncle and boil.
4. Thermal gangrene: frost-bite, burns, and scalds.

**Name the different methods for arresting arterial hemorrhage.**

Direct pressure, acupressure, forcipressure, torsion, cauterization, and ligation.

**Is necrosis found more frequently in the inferior or in the superior maxilla? Why?**

Necrosis is found rather more frequently in the inferior maxilla because its blood supply is not so abundant.

**Differentiate a syphilitic ulcer of the tongue from a traumatic ulcer of the tongue.**

Syphilitic ulcer.—There is a superficial crack or fissure upon the side or tip of the tongue. Such fissures may be multiple, chronic, or relapsing. It is common in the secondary period of the disease, and is often accompanied by mucous patches, by similar ulcers upon the cheeks, or by papillar eruptions upon the skin. It improves under specific treatment.

Traumatic ulcer.—The ulcer is usually situated upon the side of the tongue, is ragged or irregular in outline, and is usually opposite a collection of tartar, an angle of a tooth, or the edge of a plate. The glands are not enlarged. Recovery follows the removal of the local irritant.

**Define orthodontia.**

By orthodontia is meant the correction of irregularities of the teeth.

**State the best method of sterilizing instruments.**

The best method of sterilizing instruments is to boil them for ten minutes in a 1% solution of sodium carbonate.

**What are the causes of secondary hemorrhage?**

Chief cause: Septic arteritis.

Contributory causes: 1. Early absorption of ligature. 2. Faulty application of ligature. 3. Ligature too near a collateral branch. 4. A diseased condition of the arterial wall. 5. A state of blood unfavorable to repair of any wound (albuminuria or diabetes). 6. Increased blood pressure (plethora, Bright's disease, fever, injudicious excitement, or unwise administration of stimulants).

**Define staphylorrhaphy. State the most favorable age for the operation.**

By staphylorrhaphy is meant the plastic operation for closing a cleft in the soft palate.

The most favorable age for the performance of the operation is between the second and third year. It is very important that staphylorrhaphy should be performed before the child commences to talk.

**Mention two methods of preserving the aseptic character of a wound.**

The aseptic method and the antiseptic method.

**Give etiology and treatment of syncope.**

Syncope is due to anemia of the brain produced by sudden failure of the heart's action.

Lay patient flat on his back with the head low. Make friction over the præcordial region or apply galvanism. Apply smelling salts to nostrils and give a little brandy as soon as the patient can swallow.

**Give the clinical appearance and treatment of osteoma of the inferior maxilla.**

Osteoma of the inferior maxilla may consist either of a general thickening or enlargement of the entire bone or of a local outgrowth. The tumor is extremely hard, grows slowly, and causes no pain unless it presses upon important sensory nerves. The neighboring lymphatic glands are not enlarged.

Treatment.—These tumors are best left alone unless the deformity is great or the movements of the mandible are interfered with. They may be partially excised, the offending portions being chiselled, drilled, or ground away, or they may be wholly removed by excising a portion of the mandible.

**Describe suppurative cellulitis.**

The affected part is hot, tender, and infiltrated; if superficial, it looks red and angry and is brawny to the touch. Fever is usually present and, in severe cases, one or more rigors may occur. If the part is not incised, the process rapidly spreads throughout the entire extremity or region; the toxic fever rapidly exhausts the patient's strength and the entire subcutaneous and intermuscular areolar tissue of the part is destroyed.

**Define surgical shock. Give the treatment.**

Surgical shock is the immediate constitutional effect of an injury.

Treatment.—When slight, rest in the recumbent posture and the use of some aromatic stimulant (ammonia). If severe, recumbent position with the head low; surround the patient with hot bottles (well protected) and blankets to maintain and bring up body-temperature. If conscious and able to swallow, give a little warm tea or stimulant; if unconscious, a small hot coffee or brandy enema, or a hypodermatic injection of ether or strychnine. Care should be taken not to waste vital power by over-stimulation which will result in excessive reaction. The intravenous injection of normal saline solution frequently gives excellent results. If the

shock is maintained by the presence of a mangled limb, it may be well to perform an amputation.

**What diseases of the tongue may be mistaken for carcinoma?**

Primary, secondary, or tertiary syphilis, leukoplakia, chronic glossitis, traumatic ulcers, tubercular ulcers, sarcoma, and actinomycosis.

**Mention two varieties of cysts of the tongue. Give the treatment of one variety.**

Dermoid cyst.—Retention cyst, due to the occlusion of the duct of a small mucous gland.

The retention cyst is best treated by excision.

**Mention the materials employed for sutures, and describe the twisted or hare-lip suture.**

Silk, silkworm-gut, catgut, kangaroo tendon, silver wire, and horse-hair.

The hair-lip or twisted suture consists of metallic pins or needles thrust through both lips of the wound, the edges of which are kept in contact over the pins by figure-eight turns of silk.

**Give the etiology, clinical appearance, and the treatment of acute ranula.**

Acute ranula is an accumulation of saliva (from obstruction and rupture of Wharton's duct) in a serous sac known as Fleischmann's bursa (Tillaux). Duplay considers the acute ranula to consist of a dilation of the duct itself.

The cystic tumor is situated in the floor of the mouth to one side of the median line. It is globular, semi-transparent, and may attain the size of a bantam's egg, pushing the tongue upwards and backwards and interfering with deglutition and speech. It contains a glairy mucous fluid.

Treatment.—Excision of a portion of the anterior wall of the cyst and swabbing out the cavity with pure carbolic acid. The cavity is then packed with iodoform gauze and made to



heal by granulation. If the condition recurs, the entire growth is to be excised.

**Mention the varieties of displacement in fracture of the inferior maxilla. Give the symptoms and treatment of one variety.**

In fractures through the angle, or lower part of the ramus, there is usually little displacement, as the masseter on the outer side and the internal pterygoid on the inner side, maintain the fragments in apposition. When the fracture passes through the neck of the condyle, that process is drawn forward and inward by the external pterygoid, whilst the body of the bone is freely movable antero-posteriorly, and is displaced toward the sound side.

When the coronoid process is detached, it is drawn upwards by the temporal tendon, but no great displacement can occur, owing to the extensive attachment of the tendinous fibres.

In the most common fracture, through the body of the bone near the mental foramen, the large anterior fragment is displaced downwards by the muscles passing from the hyoid bone to the jaw. The smaller fragment is drawn upwards by the muscles of mastication and is displaced outwards, so that it overlaps the anterior fragment.

In a fracture through the body of the jaw there will usually be hemorrhage from the mouth, irregularity of the denture, crepitus, and a displacement as described above. The treatment consists of the reduction of the displacement, the application of a Barton bandage and the maintenance of an aseptic condition of the oral cavity. If necessary, Hammond's splint may be applied.

**Define neurasthenia and give its symptoms and treatment.**

A condition of lack of power of the nerve-centers, not dependent upon the existence of organic disease in any portion of the body.



Symptoms.—Loss of weight and slight anemia, excessive irritability of the heart, spots of local tenderness over the spine, weariness upon exertion, weakness of memory, disturbance of sleep, flushes of heat, profuse sweating, and occasionally disturbances of sensation.

Treatment.—Rest, with change of scene and diet; massage, out-of-door life, avoidance of excitement, strychnine in full doses, and, best of all, the “rest cure” as prescribed by Dr. S. Weir Mitchell.

**Define odontoma. Give the classification, clinical appearance, and the treatment of odontoma.**

An odontoma is a tumor originating from some abnormal condition of the teeth or teeth germs.

1. Epithelial odontoma. Originates from enamel organs, usually affects lower jaw, forms tumor of great size, and as a rule runs a perfectly benign course. The only treatment consists in complete removal of the affected portion of the jaw.

2. Follicular odontoma (dentigerous cysts). More common in lower jaw, tumor, at first, hard and solid, but subsequently gives egg-shell crackling and even fluctuation. A permanent tooth will be found missing, and there is no history of its having been extracted. The treatment consists in excising a portion of the wall of the cyst from the mouth and extracting the misplaced tooth. The interior of the cyst is then to be thoroughly scraped, flushed with an antiseptic solution and packed with gauze.

3. Fibrous odontoma. Occurs rarely in rickety children; there is thickening and condensation of the connective tissues around a tooth-sac. Treatment, thorough removal.

4. Radicular odontoma. A tumor composed of cement developing at the root of a tooth. It causes severe pain and may result in septic inflammation of the surrounding bone. Treatment, thorough removal.

5. Composite odontoma. These may be very large and resemble osteomata of the antrum. Treatment, thorough removal if causing trouble.

**Give the etiology, clinical division, pathologic classification, and the treatment of tumors.**

Etiology. — Injury or irritation, infection, heredity, fetal residues.

Clinical Division. Benign and Malignant.

Pathologic Classification.

I. Mesoblastic or Connective Tissue Tumors.

A. Those conforming to the types of fully formed connective tissues:

1. Fibroma.
2. Lipoma.
3. Chondroma.
4. Osteoma.
5. Myxoma.

B. Those conforming to the types of the higher connective tissues:

1. Myoma.
2. Angioma.
3. Lymphangioma.
4. Neuroma.

C. Those conforming to the types of embryonic connective tissue: Sarcoma.

II. Epiblastic and hypoblastic tumors, *i. e.*, those conforming to the type of Epithelial Tissues:

1. Papilloma.
2. Adenoma.
3. Carcinoma.

III. Tumors composed of Epiblastic, Hypoblastic and Mesoblastic Elements: Teratoma.

Treatment.—In Benign Tumors, removal if annoying or if they show a tendency to become malignant.

In Malignant Tumors, secondary deposits should be removed with the primary growths. If complete removal is impossible they had best be left alone.

**Give the causes and treatment of spasmodic respiratory failure.**

Laryngitis, laryngismus stridulus, tetanus, and hydrophobia.

Treatment.—In tetanus and hydrophobia treatment is practically useless. It consists of the administration of chloral between, and of chloroform during the attacks.

In laryngitis and laryngismus stridulus, place child in hot bath. Give syrup of ipecac to produce vomiting and place hot compresses about the throat. If child cannot swallow, tickle throat with finger to produce emesis.

**Describe the operation of extracting molar teeth. Mention accidents that may occur in the extraction of these teeth.**

First and second upper molars. The operator stands at right of patient, passing the left arm around the head, and holding the lip out of place with the fingers of the left hand. In using the cow-horn forceps, take care to thrust the points of the horn directly into the interspace and then carry the flat blade along the palatine fang as high as possible. A few rocks of the tooth inward and outward combined with direct force in the line of its long axis will cause it to give way.

First and second lower molars. Position of operator as before. Use the cow-horn forceps for lower molars, and so apply them that the closure of the handle forces the points into the interspace where they will meet. If closing the handle does not loosen the tooth, gently rock the forceps inward and outward until the tooth is felt to yield, when it is at once to be lifted from its socket.

In extracting the third molar, an appropriate forceps must be selected and the traction made in the axis of the single curved root, usually backwards and upwards or downwards, as the case may be.

The accidents of extraction are: Laceration of gum, fracture of alveolar process, paralysis, excessive hemorrhage,

loosening or breaking of other teeth, and luxation of the inferior maxilla.

**Define replantation of teeth, transplantation of teeth, and implantation of teeth.**

By replantation is meant the return of a tooth to its natural socket after extraction.

By transplantation is meant the transference of a tooth from its original socket to one existing in another jaw.

By implantation is meant making a socket in a jaw where none exists and inserting a tooth into it.

**Give a differential diagnosis of traumatic ulcer of the tongue and epithelioma of the tongue.**

The traumatic ulcer is usually situated upon the side of the tongue opposite a mass of tartar, an angle of a tooth, or the edge of a plate. The ulcer is ragged, irregular, without induration (unless very chronic) and the lymphatic glands beneath the lower jaw are not enlarged.

Epithelioma occurs in middle-aged or elderly individuals. The ulcer has a widely indurated base, thick everted edge, an irregular warty surface, a watery discharge, and there is an enlargement of one or more of the submental glands.

**Give a differential diagnosis of suppuration of the maxillary sinus and tumor of the maxillary sinus.**

#### Suppuration.

#### Tumor.

History of preceding alveolar abscess or rhinitis.

No such history.

Causes same deformity, but to a less degree.

Exophthalmos, encroachment upon nasal fossæ, a flattening of roof of mouth, and a projection of the cheek below the malar bone.

Intermittent discharge of pus from nostril of affected side.

No suppuration.

Fever.

No fever.

If acute, the cheek is red, hot, and swollen, and the part is painful. May be painful or painless.

Exploratory puncture reveals pus.

Exploratory puncture does not reveal pus. It may reveal blood (sarcoma), or exploratory puncture may be impossible (osteoma).

**Give the etiology, diagnosis, and treatment of cystic dilatation of Steno's duct or of Wharton's duct.**

Etiology. — A salivary calculus may be formed within Steno's duct and completely occlude its lumen.

Diagnosis: Painful swelling in region of parotid gland, pain increased by the ingestion of food. The calculus may be readily detected by probing the duct, or it may be felt through the tissues of the cheek.

Treatment.—Remove the calculus by an incision into the overlying buccal mucous membrane.

**State how syncope spontaneously arrests hemorrhage.**

By reducing the force of the blood current and thus permitting coagulation to occur within the wounded vessel.

**Describe the Hammond wire splint and state in what class of fractures it can be successfully employed.**

It consists of a firm wire collar or framework which encircles the whole series of teeth in the lower jaw. It is accurately fitted to the jaw and fixed by several short wires passing from the lingual to the buccal wire between the teeth.

It can be successfully employed in a fractured mandible where there is much displacement.

**Define fracture. Give the local and the constitutional causes of non-union of fractures.**

A fracture is a sudden solution of continuity in a bone, usually due to excessive violence. The local causes of non-union are:

1. Faulty apposition.

2. The interposition of fluid, muscular or aponeurotic tissue, or pieces of bone between the ends of the fragments.
3. Want of rest.
4. Defective blood supply.
5. Defective innervation.
6. Inflammation on the surface of the limb.
7. Faulty treatment, and,
8. Local affection of bone (malignant tumors, destruction of the periosteum by inflammation).

The constitutional causes are:

1. General constitutional weakness.
2. Osteomalacia.
3. Scurvy.
4. Syphilis.
5. Senility (probably).
6. Pregnancy, and
7. The cancerous cachexia.

#### **Differentiate sapremia, septicemia and pyemia.**

Sapremia (septic intoxication) is a wound fever due to the absorption of the products of putrefaction into the system. It is a toxemia or condition due to chemical poisoning, and the blood is not infective.

Septicemia (septic infection) is a wound fever due to the introduction into the blood and tissues of bacteria, which rapidly multiply. The blood is infective, since it contains not only the toxins but also the organisms which produce them.

Pyemia is a wound fever developed during the process of suppuration, and is due to the absorption of pyogenic organisms into the circulation. Clinically, pyemia is septicemia plus metastatic abscesses.

#### **State precautions that should be taken when operating on syphilitic patients.**

Any cracks or abrasions upon the hands of the operator should be protected by a collodion dressing and the hands should be encased in a pair of sterile rubber gloves. At



various intervals during the operation, the hands should be immersed in an antiseptic solution and then rinsed in sterile water. At the conclusion of the operation the hands should be well scrubbed, soaked for several minutes in a bichloride of mercury solution (1-1000), and then washed in sterile water.

**In trifacial neuralgia caused by infection, malaria, or grip, what division of the nerve is usually involved?**

The first or ophthalmic division.

**What produces mechanical asphyxia during ether or chloroform anesthesia?**

Mechanical asphyxia is produced by the tongue falling backward over the glottis.

**Give the differential diagnosis of fracture and dislocation.**

**Fracture.**

**Dislocation.**

Preternatural mobility.

Immobility.

Crepitus.

No crepitus.

The deformity usually returns immediately after it has been corrected.

The deformity does not usually recur after it has been corrected.

**Give the anatomical and the clinical varieties of hemorrhage.**

The anatomic varieties of hemorrhage are the arterial, the venous, and the capillary.

The clinical varieties of hemorrhage are primary hemorrhage, intermediate or reactionary hemorrhage, and secondary hemorrhage.

**State why an alveolar abscess may cause suppurative inflammation of the maxillary sinus.**

Because the suppuration is in the floor of the sinus and may point towards its cavity or cause a suppurative inflammation by contiguity of structure.

**Mention the predisposing and the exciting causes, together with the local and the constitutional symptoms of inflammation.**

The predisposing causes include everything which lowers the general resistance of the body; such as Bright's disease, diabetes, anemia, tuberculosis, and chronic alcoholism.

The exciting causes are traumatism, heat, cold, chemical agents, and bacteria.

The local symptoms are redness, heat, pain, swelling, and modified function. The constitutional symptom is fever.

**Give the pathology, symptoms and treatment of inflammation.**

Pathology.—There are three sets of changes:

1. Changes in the blood-vessels and in the circulation. The blood-vessels dilate. The current is at first more rapid but soon becomes slower, so that an axial stream (red blood corpuscles) and a periaxial stream (white blood corpuscles and blood plaques) may be differentiated. In addition to dilating, the vessels become elongated and tortuous. The current finally becomes so sluggish that it moves onward with each systole and backward with each diastole (oscillation). This is followed by stasis.

2. Exudation of serum and transmigration of the leucocytes.

3. Changes in the tissues themselves. These consist of a multiplication of the fixed and wandering connective tissue cells.

Symptoms.—The local symptoms are redness, heat, pain, swelling, and modified function. The constitutional symptom is fever.

Treatment.—The local treatment includes rest, elevation, the use of heat or cold, local blood-letting, astringents, antiseptics, counter-irritation, compression, and massage.

The constitutional treatment comprises good hygiene, a light nutritious diet, purgatives, venesection, antipyretics, hypnotics, analgesics, stimulants, and tonics.

**Give the cause and treatment of noisy movements of the temporo-maxillary articulation.**

Cause.—Laxity of ligaments and weakness of surrounding muscles. In some cases it is due to a displacement of the inter-articular cartilage.

Treatment.—Tonics, electricity. The wearing of an occipito-mental sling. If the inter-articular cartilage is displaced an incision may be made into the joint and the cartilage sutured in its normal position.

**Define septic intoxication. Give treatment.**

Septic intoxication is a form of poisoning resulting from the absorption of the products of putrefaction.

The local treatment consists of the thorough removal of the source of infection and of the antiseptic treatment of the wound.

The constitutional treatment must be of a supporting character. Alcohol and hypodermatic injections of strychnine are to be recommended. Enteroclysis or hypodermoclysis.

**Define stomatitis. Mention the varieties of stomatitis and give treatment of one variety.**

By stomatitis is meant an inflammation of the oral mucous membrane.

The varieties are catarrhal, aphthous, ulcerative, parasitic, gangrenous, mercurial, syphilitic, and scorbutic.

Treatment of ulcerative stomatitis: Correct the hygiene. Tonic doses of quinine. Touch ulcers with nitrate of silver. Use as a mouth wash a solution of potassium chlorate or hydrogen peroxide.

**Differentiate acquired cleft palate and congenital cleft palate.**

Congenital cleft palate exists at birth and is due to want of union of the two palatal segments of the maxillary processes.

Acquired cleft palate is produced at some period of extra-uterine life by loss of substance resulting from injury or syphilis.

**How would you treat persistent bleeding after lancing the gums of a child?**

By pressure with compresses soaked in peroxide of hydrogen; by packing the incision with a pledget of cotton saturated with phenate of soda or a solution of tannic acid. In some cases the lips of the wound may be temporarily approximated by a suture. Monsel's salts and solutions are only to be used in extreme cases, since they impair the vitality of the tissues and increase the danger of secondary hemorrhage. In addition to the local treatment, one of the following hemostatics may be administered:

Tr. ergot (gtt. V, repeated in one or two hours), Tr. *erigeron canadensis* (gtt. 1, in water every minute until bleeding ceases, or until twenty doses have been taken), gallic acid (gr. 1, every two hours).

**What treatment would you pursue in excessive hemorrhage after tooth extraction?**

Remove all clots and pieces of root, plug the tooth-socket with a strip of gauze saturated with peroxide of hydrogen, and reinforce the plug by means of a supporting pad. Should this fail, a plug may be made of gauze, the meshes of which contain tannic acid or alum. The advantage of the clot formed by tannin is that it is insoluble in the blood. Perchlorid of iron and Monsel's solution should not be employed on account of their injurious effects upon the tissues and the danger of secondary hemorrhage. In obstinate cases, the hemorrhage may always be controlled by packing the tooth-socket with a strip of gauze, in the meshes of which rapidly-setting plaster of Paris has been incorporated. A pledget of cotton saturated with adrenalin chloride (1-1000) may also be used.

**Give one of the causes of antral disease, its diagnosis, and treatment.**

An alveolo-dental abscess discharging into the antrum.

The diagnosis will be made by the presence of the follow-

ing signs and symptoms: Pain over the affected region and the discovery of the offending tooth or root. Tenderness upon percussion of the antrum. The escape of pus through the nostril of the affected side. If the antrum contains a considerable quantity of pus, it will be opaque to transmitted light, as compared with the opposite side. The examination is made by taking the patient into a dark room and introducing a small incandescent lamp into the mouth, which is then closed. If the pus can find no outlet, the floor of the orbit will be pushed up, causing exophthalmos, the nasal fossae will be encroached upon, and there will be edema of the cheek.

The treatment consists in the establishment of efficient drainage and the thorough irrigation of the cavity of the antrum. This may be accomplished by extracting the offending tooth or root and enlarging the opening into the antrum. The antrum may also be entered above the root of the second bicuspid tooth, about one inch above the border of the gum. The opening into the antrum must be kept open by a gauze or tubular drain until the discharge entirely ceases. During this time the cavity of the antrum may be irrigated—at first daily, and subsequently at longer intervals.

**How would you treat a case of external fistula with adhesion from an alveolar abscess?**

The entire fistulous tract must be dissected out and all cicatricial tissue removed. The necrotic bone must be burred away until healthy bone is reached. After the hemorrhage has been arrested the adjacent skin is to be loosened up and a flap slid over the site of the bone lesion, so that the cutaneous wound shall not directly overlies the wound in the bone.

**How would you diagnose and treat hypertrophy of the gums, and in what class of persons, as to age and mentality, does it occur?**

Diagnosis.—Diffuse, spongy, bleeding overgrowth of gums. Teeth show that they have been greatly neglected and are



covered with accumulated deposits. The affection occurs after second dentition, usually between the ages of 18 and 25, in those who are ignorant and careless in their personal hygiene.

Treatment.—Remove all deposits. Clean teeth. Give antiseptic mouth washes. Instruct in care of mouth, and, if necessary, leech, incise, or excise redundant tissue, or galvanocautery may be used.

**How would you treat luxation of the inferior maxilla? Describe the lesion and treatment anatomically.**

The mechanism is as follows: When the mouth is opened the condyle slides forward upon the eminentia articularis and only a slight traumatism is necessary to displace it still further forward into the zygomatic fossa. The inter-articular cartilage may or may not follow the condyle.

The luxation may be unilateral or bilateral, more frequently the latter. The mouth cannot be closed and the lower jaw projects anteriorly beyond its normal position. A hollow may be felt just in front of the tragus, in the position normally occupied by the condyle. The condyle may be felt in front of this hollow. If the finger is inserted into the mouth, the coronoid process may be felt in an abnormal position beneath the zygoma. If the dislocation is unilateral, the symptoms are less marked, the jaw is more mobile, and the chin is displaced towards the sound side.

Treatment.—All that is needed is to depress the condyle below the level of the eminentia articularis, when the masseter, temporal and internal pterygoid muscles readily draw it back into the glenoid cavity. The patient is to be seated in a chair; the surgeon stands in front of the patient and presses downward upon the molar teeth with his thumbs, which are guarded with a towel. This pressure is continued in a downward and backward direction until the condyle clears the eminentia articularis, when the chin is raised by the fingers. The jaw is then to be kept at rest for four or five days by a Barton bandage.

**Give briefly your method of procedure in the treatment of a compound fracture of the inferior maxilla.**

The mouth, or the external wound, is to be kept as aseptic as possible. In ordinary cases, an external moulded splint may be applied to the chin, and the lower jaw held against the upper one by means of a Barton or a four-tailed bandage.

The fragments may be held in place by a wire collar encircling all of the teeth of the lower jaw. This collar is to be accurately fitted, first to a cast of the jaw and then to the jaw itself, and fixed by several wires passing from one half to the other, between the teeth.

If the teeth are defective, Kingley's splint may be employed. This consists of a vulcanite splint fitted over the alveolar process. Curved metal bars are attached to the front of the splint and extend backward over the cheeks from the angles of the mouth. The splint is kept in position by a bandage passing over the bars and under the chin. This splint will immobilize the fragments, even when the mouth is opened.

In obstinate cases the fragments may be wired.

**Give the diagnosis and treatment of a dentigerous cyst.**

Diagnosis: These cysts are usually encountered in young individuals, but may occur in later life. They are far more common in the lower than in the upper jaw. At first the tumor is hard and solid, but as the bone expands it becomes thinned, and palpation reveals egg-shell crackling or even fluctuation. Upon examination of the denture, one of the teeth will be missing and there will be no history of its extraction.

Treatment. — Excise a portion of the wall of the cyst (through the mouth) and extract the misplaced tooth. The interior of the cyst should then be scraped, irrigated, and packed with iodoform gauze.

**How would you diagnose and treat epulic tumors?**

Diagnosis. — Benign or fibrous epulis appears as a red,

fleshy mass, smooth or lobulated, elastic to the touch and probably showing some superficial ulceration. It is a painless tumor of slow growth.

Malignant or myeloid epulis forms a soft, rapidly growing, painful tumor, dusky red in color, and soon ulcerating.

Treatment.—The best treatment for fibrous epulis is to remove the growth, together with that portion of the alveolus from which it takes its origin. If necessary, a tooth on either side of the tumor must be extracted, each socket cut through vertically with a saw, and the incisions united below with a chisel. In this manner, a quadrangular piece of the alveolus is removed without interfering with the continuity of the jaw.

In malignant epulis, it is necessary to operate as early as possible and to carry the bone incision quite wide of the margin of the tumor. If the tumor is large, it may be necessary to remove the entire thickness of the lower, or the palatal segment of the upper jaw, as the case may be.

### **What is a ranula?**

A ranula is a retention cyst, due to the obstruction and dilatation of one of the ducts of the sublingual or submaxillary gland.

### **What do you know about aphthae and their treatment?**

The term “aphthae” is an old one and includes aphthous stomatitis, ulcerative stomatitis, thrush, and cancrum oris.

Aphthous stomatitis.—Seen in nursing children. Inspection reveals numerous small round vesicles on the cheek, lips, and tongue; the vesicles soon break, leaving shallow ulcers with a red areola.

Treatment.—Sterilize the milk. Correct any gastric disturbance. Use a mouth wash of boric acid.

Ulcerative stomatitis.—Attacks children and adults when in poor health or subjected to bad hygienic surroundings. Inspection reveals linear ulcers with gray sloughing bases. The

submaxillary glands are swollen. In severe cases, loosening of teeth and necrosis of bone may follow.

Treatment. — Correct hygiene. Tonic doses of quinine. Touch ulcers with nitrate of silver. Use as a mouth wash a solution of potassium chlorate or hydrogen peroxide.

Parasitic stomatitis (Thrush). Inspection reveals numerous white elevations, which on removal leave a raw surface. Microscopic examination reveals the *saccharomyces albicans*.

Treatment.—Correct the hygiene. Treat any gastric disturbance. Tonics. Some antiseptic mouth wash, such as solutions of borax, boric acid, or hydrogen peroxide.

Gangrenous stomatitis (*Cancrum oris*). — Usually seen in debilitated children and after one of the specific fevers, particularly measles and whooping-cough. The cheek is the part affected. Externally, it is swollen, hard, red, and glazed; internally, an irregular sloughing ulcer is noted.

Treatment. — Good hygiene and stimulants. Chloroform the child and excise the gangrenous area, cutting widely into healthy tissue. The edges of the wound are then cauterized with fuming nitric acid, bromine, or the actual cautery. The resulting deformity must be treated later by a plastic operation.

### **Describe trismus and how it differs from tetanus.**

Trismus simply means a spasmodic locking of the jaws. It may have its cause in associated dental lesions, causing irritation of the nerves of the part; it is also a symptom of tetanus.

Tetanus is an acute infectious disease, due to the bacillus of tetanus and characterized by tonic spasms with clonic exacerbations. The spasms also affect the muscles of the trunk.

### **What is a traumatic lesion?**

A traumatic lesion is a solution of continuity due to injury.

**By what surgical operation would you abort an impending alveolar abscess?**

Make a slight cut with a sharp scalpel through the soft

parts of the apex of the affected tooth. Pierce the outer plate of bone with a spear-pointed drill, thus entering the region in which the suppuration is impending. This wound should be kept patulous for several days.

**What are the indications for the use of the lance in deciduous dentition?**

The lance should never be used until the appearance of the white line, which is due to the pressure exerted by the erupting tooth. Lancing should never be performed unless reflex disturbances are produced.

**What anatomical irregularity of the inferior third molar tooth frequently presents itself in extraction? Anticipating this condition, how would you extract it?**

The roots of the inferior third molar are almost always fused and curve backward. This throws the tooth against the second molar. Always endeavor to determine the course of the root, and then make traction in a corresponding direction, usually upwards and backwards.

**Name some of the forms of sutures employed in the closing of surgical wounds, and what substances are used?**

The interrupted, the continuous, the mattress, the quilled, and the shotted suture.

The materials employed are silk, silkworm-gut, cat-gut, kangaroo tendon, and silver wire.

**What is torsion, and when is it preferable to other means in arresting hemorrhage?**

By torsion is meant the twisting of an artery until its middle and internal coats are lacerated.

It is preferable to other means in plastic operations, where it is not considered desirable to leave too many ligatures behind. It is also preferable where aseptic ligatures cannot be obtained.

**When it is surgically necessary to make an incision through a muscle and a choice exists for carrying the in-**



**cision parallel or transverse to the fibres of the muscle, which way would you adopt, and why?**

Make the incision in the direction of the fibres. The reason for this is that fewer fibres will be severed and the function of the muscle will be practically unimpaired.

**What is a sequestrum?**

A sequestrum is a piece of dead bone resulting from necrosis.

**At what point is the trunk of the facial nerve most liable to injury? If severed, what change occurs?**

At its exit from the stylo-mastoid foramen. If severed, a paralysis of the muscles of expression of the affected side is produced. The folds and wrinkles are obliterated upon the paralyzed side. The eyelid cannot be completely closed. On attempting to laugh or show the teeth, the muscles of the non-paralyzed side alone are contracted, and marked asymmetry results from the drawing over of the opposite side. The lips cannot be closed firmly, and whistling is impossible. Food collects between the cheek and the teeth, owing to the paralysis of the buccinator muscle.

**What is hare-lip? Describe a remedial operation and give the best age for its performance.**

A hare-lip is a congenital fissure of the upper lip, which may extend for a variable distance through the tissues.

Rose's Operation. The incision extends from the apex of the cleft, or from within the nostril, in a concentric manner so that a slight angular projection is formed to constitute a prolabium. This is done on each side and, where the nose is much flattened, more tissue is removed from the outer than from the inner side, so that when the parts are sutured together, the nostrils become as nearly symmetrical as possible. By this means the depth of the lip is increased to allow of subsequent contraction; the vermilion borders must be accurately approximated. Two deep silkworm-gut sutures should

be introduced, one just above the red margin and one close to the nose. Cat-gut sutures are used to bring the margins of the wound together accurately. The dressing consists of gauze and collodion. The gauze is cut in the shape of a paddle, the broad ends being fastened to the cheek. This should be so applied as to prevent tension upon the wound. The silkworm-gut sutures are removed upon the fourth day.

The best age for the performance of the operation is from six weeks to three months.

**Define ankylosis. Give an example.**

Ankylosis is a condition of partial or complete immobility of a joint, resulting from some preceding inflammation of the articular structures. As an example might be given that form which is seen in the elbow joint after fractures into the articulation, and the subsequent period of enforced rest.

**How are fractures classified?**

Simple.—Not communicating with the external air.

Compound.—Communicating with the external air.

Comminuted.—A number of small fractures.

Complicated.—Associated with a dislocation or with a laceration of the main arterial or nervous trunk.

Fractures are also divided into complete and incomplete.

According to the line of fracture, they are called longitudinal, transverse, oblique, stellate, etc.

**Describe several methods for arresting hemorrhage in general.**

Ligation.—Make an incision at a slight angle to the line of the artery. Expose the sheath. Make as small an opening in the sheath as possible and pass a ligature about the vessel by means of an aneurysm needle. Tie the ligature tight enough to lacerate the inner and middle coats.

Torsion.—Dissect the end of the artery free from the sheath for half an inch. Seize it transversely with a hemostatic forceps, and then twist the free end of the artery by means

of a second hemostatic forceps until the internal and middle coats are lacerated.

Arrest capillary hemorrhage by filling the wound with hot water (125° F.).

**Give the etiology, clinical appearance, and the treatment of spongy gums.**

Etiology.—Stomatitis, systemic derangement of any kind, from mild fevers to acute diseases, uncleanness, calcareous deposits around the necks of teeth.

Clinical appearance.—The gums appear swollen and flabby around the necks of the teeth. They have a peculiar spongy appearance and their margins are dotted and streaked with bright red spots and lines. They bleed upon the slightest provocation.

Treatment.—Removal of exciting cause, cleanliness, local blood-letting, the use of antiseptic mouth-washes and systemic treatment according to condition of general health.

**Give the etiology, pathology and treatment of pericemental abscesses.**

Etiology.—Infection from the root or from a pocket of pus (as in pyorrhea alveolaris). A deposit of uric acid upon the root may irritate the surrounding tissues and lessen resistance to infection.

Pathology.—The same as that of any other abscess.

Treatment.—Secure free drainage for pus, render the abscess cavity as aseptic as possible, and prescribe an antiseptic mouth-wash.

**Give the etiology, clinical appearance, and treatment of arsenic necrosis of the alveolar process.**

Etiology.—The arsenic usually gains access to the alveolus from an application made to the pulp.

Clinical appearance.—A red tumefied area in the center of which a slough is located. The process generally extends down into the alveolus and affects the septa between the teeth.

Treatment.—Removal of necrotic tissue. The local application of sesqui-oxide of iron has been highly recommended. Repeated syringings and antiseptic mouth-washes.

**Give the method of removing a broken bur or nerve broach from a pulp canal.**

Drill around the bur with a fine fissure drill; iodine may be applied and the part rusted out; sulphuric acid may be used to remove some of the tooth structure, or an attempt may be made to draw out the bur with a barbed Donaldson broach.

**Give the causes, pathologic conditions, and the symptoms of traumatic dislocation.**

Causes.—The application of external violence and muscular force, acting alone or in combination.

Pathologic conditions.—The ligaments are partially or completely torn. In closely fitting joints (particularly hinge-joints, the bony surfaces are frequently fractured. The cartilages may be bruised or partially detached and the neighboring muscles and tendons lacerated or displaced. Surrounding vessels and nerves are frequently injured and the area involved is always infiltrated by a considerable effusion of blood.

Symptoms.—Pain, bruising, and swelling of the soft tissues. Deformity, since the articular end of the bone is displaced into a new position where it may often be felt and sometimes seen. Restricted mobility of the affected joint. True crepitus is not present unless a fracture co-exists.

**Give the diagnosis, prognosis, and treatment of moist gangrene of the pulp.**

Diagnosis.—If there is an outlet for the escape of the gases of decomposition, pain is not necessarily experienced. Ordinarily, however, the condition causes more or less intense pain, which is usually of a throbbing and heavy character. If inflammation has spread to the surrounding tissues, the

application of heat may cause an increased amount of pain. A foul-smelling odor is constantly present.

Prognosis.—Not necessarily bad. The tooth may be saved in a majority of cases.

Treatment.—Removal of all decomposed parts and products, disinfection of pulp canal, hermetical sealing of apex of the tooth, and filling of the pulp canal.

**Give the etiology, diagnosis, and treatment of acute non-purulent marginal gingivitis.**

Etiology.—Mechanical or thermal irritants (such as rough edges of an overhanging filling), rough treatment in excavating or filling a cavity, overheating while drying a cavity, friction while excavating with bur, or cutting down of fillings with sand-paper discs, careless use of ligatures (particularly when they are left upon the tooth for some time), the use of some strong caustics, or other drugs.

Diagnosis.—Severe pain, usually of a throbbing character and other local signs of inflammation. The tooth is slightly loose, and protrudes somewhat from its socket.

Treatment.—Removal of cause, local blood-letting, paint parts affected with iodine.

**Give the clinical appearance and the treatment of syphilitic interstitial gingivitis.**

Inflammation, attended with superficial ulceration of mucous membrane and general oozing of a grayish-white color.

Treatment.—Iodides internally. Antiseptic mouth-washes locally.

**Describe the “direct method” of producing artificial respiration.**

In the direct method, the air is warmed and pumped into the lungs. The apparatus required is a pair of bellows, a face mask, and intubation tubes (in case the mask does not suffice). There should be a metal tube, with an opening in it, set in the rubber tubing, so that the operator can allow



the escape of any excess of air blown by the bellows. If the mask is used a ligature should be passed through the tongue so that it may be readily held forward. If the air cannot enter the lung, intubation is to be performed, and there will be no difficulty. A respiratory rate of 16 to 20 a minute should be maintained. If there is no apparatus for warming the air, the temperature of the room must be raised to at least 85° F.

**Give the etiology, pathology, symptoms, and treatment of hyperemia of the pulp.**

Etiology.—Irritation of bacteria, lactic acid, traumatism, exposure, denudation of root, and irritation from a filling.

Pathology.—Practically that of a beginning inflammation. When cut into it bleeds rather freely.

Symptoms.—Pain, increased by percussion, or by the application of either hot or cold substances.

Treatment.—Local and general sedatives. Counter-irritation. If pulp does not respond, local blood-letting. As a last resort the pulp may be destroyed.

**What precautionary measures should be observed in the ligation of arteries?**

Asepsis, avoid wounding important surrounding structures, make as small an opening as possible in the sheath, never tie near a collateral branch (or if forced to do so, tie branch also), and be sure that the ligature damages the inner and middle coats sufficiently to insure the obliteration of the vessel at that point.

**Give the treatment of septic wounds.**

Cleanse the wound as thoroughly as possible, syringe with hydrogen peroxide, and irrigate with bichloride (1-1000). If the septic condition of the wound is marked, solutions of chloride of zinc should be applied to all of its recesses. If the wound is large and irregular, rubber drainage tubes should be introduced into the most dependent positions. If the wound is small, gauze drainage may suffice. The best

dressing is one of wet bichloride gauze. The constitutional treatment should be of a supporting character.

**Give the etiology, symptoms, and treatment of acute periostitis of the inferior maxilla.**

Etiology.—Traumatism, extension from a contiguous inflammation (such as an alveolar abscess), the exanthemata (particularly measles and scarlet fever). It may also be caused by general conditions, such as rheumatism, gout, or pyemia.

Symptoms.—The ordinary phenomena of acute inflammation. The pain is of an intense aching character, worse at night, and increased by pressure. If the outer surface is involved, and the process go on to suppuration, a brawny swelling develops which softens in the center the overlying skin becoming reddened and edematous. When the abscess is opened, bare bone is felt, and the greater portion of the denuded structure dies.

Treatment.—Rest, leeches, and fomentations locally, if seen early. A good purge should be given, and any underlying diathesis treated. If suppuration is threatened, a free incision should be made down to the bone. If necrosis has occurred, the parts must be dressed antiseptically, until the sequestrum is detached. If the sinus opens internally, antiseptic mouth-washes.

**Give the etiology and treatment of epistaxis.**

Etiology.—Traumatism, ulcers or tumors of the nasal septum, rupture of varicose veins in mucous membrane of septum, cerebral congestion, hemophilia, purpura, scurvy.

Treatment.—In the majority of cases there is a local cause. If the bleeding point is detected, it should be touched with a pointed galvano-cautery or with a swab saturated with a solution of chromic acid. Cold may be applied to the root of the nose and to the nape of the neck. If the bleeding-point cannot be located, the anterior nares should be packed with strips of aseptic gauze saturated with hydrogen per-

oxide. If the hemorrhage still continues and the blood drips into the nasopharynx, the posterior nares must be plugged with the aid of Belloeq's sound or a rubber catheter.

**Describe the necessary preparation of patients for general anesthesia by ether or chloroform. State what remedies and instruments should be at hand.**

The patient should be examined as carefully as though he were an applicant for life insurance, and all organic diseases should be excluded. This includes physical examination of the lungs, heart, abdomen, etc., and chemical and microscopical examination of the urine. The night before the anesthesia the patient should receive a half-ounce of Epsom salts, and on the morning of the operation the lower bowel should be emptied by enema. Just before the anesthesia all loose bodies, false teeth, etc., should be removed from the mouth. No food should be taken for at least six hours before the anesthesia.

Instruments and remedies.—Sterile hypodermatic syringe and sterile solutions of atropine sulphate, strychnine sulphate, nitro-glycerine. Brandy, ammonia, tongue forceps, and mouth gag. Tracheotomy instruments, a battery, and an apparatus for forced artificial respiration should always be within reach in a hospital.

**Give the treatment of wounds of the tongue.**

Arrest hemorrhage by exposure to the air, ice, hot water or ligation. If wound is small, sutures are not required. If large, deep-seated sutures should be introduced and the ends tied with more than ordinary care, since the motions of the tongue are apt to loosen the suture. An antiseptic mouth-wash should be prescribed.

**Define scarification. Give the method of this operation and state the results obtained, mention the necessary precautions to be observed in scarification.**

By scarification is meant the operation of making numerous small superficial incisions.

The incisions should be parallel, arranged in the form of a lozenge, and extend almost through the skin.

The results obtained are bleeding and the relief of tension.

The necessary precautions to be observed are the details of rigid asepsis.

**Mention three tumors of antrum. Give treatment.**

Osteoma, sarcoma, and carcinoma.

Treatment.—The osteoma requires no treatment unless it presses upon important structures, or causes great deformity, when the offending portions of the tumor may be removed. Before such a partial operation is done, however, malignancy must be absolutely excluded. If a sarcoma or carcinoma can be thoroughly removed by an excision of the superior maxilla, this operation is indicated. If the malignant growth cannot be thoroughly removed, the toxins of erysipelas may be injected.

**Give the local treatment of hemorrhage.**

Exposure to air, cold, hot water, position (usually elevation), direct pressure, styptics, cauterization, acupressure, forcipressure, torsion, and ligation.

**Give treatment of injuries of the mouth caused by carbolic acid.**

Apply alcohol as quickly as possible to dissolve excess of carbolic acid. An antiseptic mouth-wash should then be used.

**Give the diagnosis and treatment of papillomata of the gums.**

Diagnosis.—It is an innocent epithelial tumor consisting of a fibrous stroma which contains blood-vessels, lymphatics, and an epithelial covering peculiar to the part from which it springs. The tumors are generally multiple, wart-like growths, usually soft and seen upon the mucous membrane. They do not, as a rule, give pain, and are either smooth, rounded or of cauliflower shape. They are generally very vascular and bleed quite freely. Treatment.—Immediate and

thorough removal since they show a most pronounced tendency to become malignant.

**Describe the technic of ligation of arteries.**

Thoroughly asepticize the part. Make an incision over the line of the artery. It is best to make this incision at an angle of five degrees to the line of the vessel. Divide the structures layer by layer, avoiding important vessels and nerves. After dividing skin, superficial and deep fascia, the pulsations of the vessel should be sought for. When the sheath of the vessel is reached, it should be opened as far away from the vein as possible (example, open carotid sheath upon *inner* side). This opening in sheath should be just large enough to allow room for the aneurism needle. In passing the aneurism needle always go from the most difficult to the least difficult side, and never lift the artery up from its bed to a greater extent than is absolutely essential. Before tying the ligature be sure that it controls the circulation. In tying the ligature exert an equal amount of force upon both ends. After the vessel is ligated, the cutaneous wound is sutured and an aseptic dressing is applied.

**Give the differential diagnosis of ozaena and empyema of the antrum.**

In ozaena, the offensive discharge proceeds from both nostrils, and the nasal mucous membrane is atropic. The maxillary sinuses transmit light when the patient is in a dark room with an incandescant lamp in the mouth. There is an absence of any inflammatory symptoms in the tissues overlying the antrum.

In empyema of the antrum, the discharge proceeds from the nostrils of the affected side; the nasal mucous membrane upon the opposite side may be normal; and the diseased maxillary sinus is more opaque to transmitted light than is the normal antrum. There are inflammatory symptoms in the tissues overlying the antrum. The cause of the empyema (such as an alveolar abscess) may be found.



**Give the diagnosis and clinical appearance of myeloid sarcoma.**

Myeloid sarcoma always grows from bone. It affects the long bones (particularly the upper end of humerus and tibia, lower end of femur). It most commonly affects individuals between 10 and 40 years of age, but it may occur in old age. The tumor is one of rather slow growth; it may pulsate, fluctuate in certain portions of its extent, or give rise to egg-shell crackling.

**Give treatment of fracture of superior maxilla. State the complications that may arise.**

Correct any displacement; as a rule, all the treatment required is to keep the patient quiet and apply cooling lotions to the part. The patient should be fed through a tube if the palatal process is involved. A dental plate should be applied to a broken alveolus.

The complications that may arise are severe hemorrhage, suppuration (empyema of antrum), and necrosis.

**Give the clinical appearance, the symptoms and treatment of necrosis caused by an impacted wisdom tooth.**

The gums are usually discolored, slight bleeding is common, pus exudes from numerous openings over affected area. Pain may or may not be present. If the condition is allowed to persist, the general health is impaired.

Treatment.—Remove cause by extracting the malplaced tooth; antiseptic mouth-washes should be freely employed. The necrosed portions of the alveolus should be freely removed.

**Give the diagnosis and treatment of fracture of the inferior maxilla.**

Crepitus may be obtained. The condyle is usually drawn forwards and inwards by the external pterygoid, while the body of the bone is freely movable antero-posteriorly, and is displaced towards the fractured side.

Treatment.—Barton's bandage. Intermaxillary splints are deservedly unpopular. The most perfect results are undoubtedly obtained by wiring.

### **Differentiate neuritis and neuralgia.**

By neuritis is meant the inflammation of a nerve.

By neuralgia is meant severe paroxysmal pain along the course of a nerve, and not associated with demonstrable structural changes in the nerve.

The pain of neuritis is increased by pressure; the pain of neuralgia is frequently relieved by pressure. A differential diagnosis is sometimes impossible.

### **Give the etiology and clinical features of epithelioma of the lip.**

Etiology.—It is commonly stated that this tumor is due to the irritation produced by smoking a short clay pipe, which is allowed to rest on one or the other side of the lip near the angle. It may also originate opposite a projecting rough or carious tooth.

Pathology.—The affection may be a typical malignant ulcer, a wart-like growth subsequently becoming fungus and ulcerated, or a chronic infiltration leading to an irregular, nodular thickening. Sections of the growth show an abundance of "epithelial pearls."

Clinical features.—Almost always affect lower lip. Rarely met with in women (1 in 20). Occurs past middle life. Submental and sub-maxillary glands not implicated for three or four months. Sore develops slowly. Sharp burning or lancinating pains. Odor often extremely offensive.

### **Why should the hands be disinfected before a surgical operation. Describe the method used.**

Because the epidermis always contains pathogenic bacteria.

Furbinger's method.—Hands and forearms are scrubbed continuously for five minutes with soap and aseptic nail-brush. The nails should be thoroughly cleaned and trimmed short. The hands are then plunged into absolute alcohol for

at least one minute, and then are plunged while wet into a hot sublimate solution (1-1000) and thoroughly scrubbed with a nail-brush for at least one minute, particular attention being directed to the nails.

A better method is that of Kelly: The hands and forearms are cleansed as before with soap and water and the nails cleaned and pared. The hands and forearms are then immersed in a saturated solution of potassium permanganate until they are stained a deep mahogany red, or almost black. They are then immersed in a saturated solution of oxalic acid until they are completely decolorized. The oxalic acid is then washed off in sterile water.

**Describe the methods used in plastic surgery.**

Displacement.—Stretching or sliding of tissues. 1. Simple approximation after freshening the edges. 2. Sliding into position after transferring tension to adjoining localities.

Interpolation.—Borrowing material from adjacent regions, from a limb or from another person. 1. Transferring a flap with a pedicle. 2. Transplanting without a pedicle.

Retrenchment.—Removing redundant material and causing cicatricial contraction.

**Describe local anesthesia. State the precaution necessary in producing it.**

Local anesthesia is best effected by the use of cocaine, and may be employed with safety when the cocaine can be confined to a limited area. The part, say a finger, is aseptized and a stout ligature or fillet placed about its base. The cocaine is then injected between the layers of the skin and also in the vicinity of the digital nerves. The entire finger will be anesthetized within three or five minutes.

Precautions — Asepsis. — Never risk the absorption of an amount of cocaine which exceeds the normal dose. At the conclusion of the operation, loosen the ligature and then tighten it again after five or ten seconds. Repeat at intervals so that the cocaine in the tissues will not all be absorbed at one time.

**Give the clinical appearance of squamous lesions of syphilis in the mouth.**

The epithelium is whitish and opaline, resembling a surface that has been touched by nitrate of silver. If eroded, the surface is red and smooth after the superficial epithelium has desquamated. The patch is always circular or regularly oval and the derma is thickened upon its surface.

**Give a differential diagnosis of an abscess, a cyst and a fatty tumor.**

An abscess is characterized by redness, heat, pain, swelling, fever, fluctuation, pointing, and the hypodermatic needle reveals pus.

A cyst is characterized by an absence of inflammatory symptoms, unless it is inflamed. Fluctuation is present and the hypodermatic needle reveals a non-purulent fluid. A superficial cyst can be better outlined than is the case with an abscess.

A fatty tumor is inelastic and doughy to the touch. It is adherent to the skin and, when it is moved, causes a dimpling of the overlying integument. There is an absence of inflammatory symptoms.

**State a method of sterilizing sponges.**

The sponges should be placed in a muslin bag and well pounded to remove all particles of sand and other foreign materials. They are then rinsed out in water several times. A very good way is to place them in a basin or pail, and allow the water to run in upon them from a tap for several hours. They are next soaked in a saturated solution of permanganate of potassium, are afterwards decolorized in a solution of oxalic or of sulphuric acid, and are then left for twenty-four hours in an aqueous solution of hydrochloric acid, made strong enough to taste slightly sour. After this, they are again soaked in water until the washings are clear. They are next placed in a bichloride solution (1-500) for twelve hours, and finally are rinsed in warm water and pre-

served in covered glass jars containing a three per cent. aqueous solution of carbolic acid, the solution being changed every week.

**What class of patients should not be anesthetized by (a) nitrous oxide, (b) chloroform, (c) ether?**

(a) Those with diseased blood-vessels. Those in whom complete muscular relaxation is desired.

(b) Those with myocardial disease.

(c) Those with bronchitis or Bright's disease.

**Give reason for removing a blood clot from the surface of a wound.**

The chief reason for removing a clot is that it is capable of forming a most excellent culture medium for the growth of bacteria. Its presence consequently favors the development of sepsis. If the clot is not removed by the surgeon, it will be removed by nature, since it is nothing more nor less than a foreign body.

**Give the etiology and treatment of erosion.**

Etiology.—Acids attacking the necks of the teeth. The acid may proceed from the buccal glands or be regurgitated from the stomach.

Treatment.—Applications of milk of magnesia, chalk, or some such alkaline substance. Correct any digestive defect and destroy the glands by the cautery, if they can be definitely located. The eroded places should be filled.

**Give the method of operation for exposing the inferior dental nerve.**

Incision, two inches in length, along the lower border of the jaw, beginning slightly behind the angle and well under the border. The upper edge of the wound is displaced upward over the ramus, the masseter muscle is separated from the bone with a periosteal elevator, and a  $\frac{3}{4}$ -inch trephine applied one inch and a quarter above the angle. This exposes the nerve at its entrance into the inferior dental foramen.



The nerve may be brought to the surface by a small hook, or the incision may be prolonged above and parallel to the edge of the jaw and the canal for the nerve laid open all the way to the mental foramen.

**What dangers may result from punctured wounds?  
Give treatment.**

The greatest danger is sepsis. Another is tetanus. A lesser danger is injury of deep structures.

Treatment.—Secure efficient drainage and pack the wound so as to make it heal up from the bottom. Infection with tetanus should be guarded against by opening up all parts of the wound so that the oxygen of the air may gain free access.

**Describe Barton's bandage.**

The roller should be two inches in width and six yards in length. The initial extremity of the roller is placed on the head just behind the mastoid process. The bandage is then carried under the occipital protuberance, obliquely upward, under and in front of the parietal eminence, across the vortex of the skull, then downward over the zygomatic arch, under the chin, thence upward over the opposite zygomatic arch and over the top of the head, crossing the first turn as nearly as possible in the median line, and thence carrying the turns of the roller under the parietal eminence to the point of commencement. The bandage is then passed obliquely around under the occipital protuberance and forward under the ear to the front of the chin, thence back to the point from which the roller started. These figure-eight turns over the head and the circular turns from the occiput to the chin should be repeated, each turn exactly overlapping the preceding one until the bandage is exhausted.

**Differentiate an ulcer and a fistula.**

An ulcer is a solution of continuity of the skin or mucous membrane due to molecular death of the part.

A fistula is a suppurating tract connecting a cutaneous or mucous surface with a normal cavity of the body, or connect-

ing two normal cavities. Strictly speaking a fistula always has two openings.

**Give the diagnosis of ulcerating gumma of the oral cavity.**

Preceding history of syphilitic infection and the presence of an inflammatory swelling, the surface of which is ulcerated. The ulcer is deeply excavated, the edge is undermined, the surrounding tissues are hyperemic, and there is a tough or soft tenacious slough adherent to its base. There is no glandular involvement, as a rule; the sore will heal under specific treatment and leave a depressed scar or a perforation.

**Give the differential diagnosis between malignant and non-malignant tumors of the upper jaw.**

Malignant tumors grow rapidly, give metastasis, are painful, recur after removal, may ulcerate, and finally cause death.

Non-malignant tumors grow slowly, do not give metastasis, are not painful (except by pressure), do not recur after removal, rarely ulcerate, and do not cause death (except mechanically). The malignant tumors of the upper jaw are of more frequent occurrence than are the benign.

**Give the direction for diagnosis of mercurial stomatitis.**

The diagnosis is made by observing the following points: The individual may work in mercury or have been taking the drug internally. There will be tenderness of the gums, manifested by bringing the teeth forcibly together, redness of the gums near the insertion of the teeth, a metallic taste, profuse salivation, fetor of breath, the tongue may be reddened, swollen, and ulcerated, and protrude from the mouth. In severe cases, ulceration of the mucous membrane, loss of teeth, and necrosis of the jaw may result.

**Describe a four-tailed bandage.**

This bandage is prepared by taking a portion of a roller bandage, three inches wide and one yard in length, and splitting each extremity up to within two inches of the center.

The undivided portion of the bandage is placed upon the point of the chin. The two lower tails are then drawn up and tied over the vortex while the two upper tails are secured behind the occiput and then, to prevent slipping, these ends are knotted to the ends of the former.

**What precaution should be taken in extracting molars and bicuspids of the inferior maxilla?**

The usual antiseptic precautions, such as sterilization of instruments, and cleansing of parts by germicidal solutions. The selection of a proper forceps, the history as to previous extraction, whether difficult or a tendency to hemophilia, and above all, keep in mind the fact that fracture may occur either in the body or in the alveolar process if violence is used. The jaw may also be dislocated. The proper motion for loosening root attachments should be applied and some guard placed over the upper teeth to prevent breaking them. Be prepared to treat shock and hemorrhage.

**Give the pathology and treatment of epithelioma.**

**Pathology.**—Squamous epitheliomata are nodula or wart-like elevations of the skin or mucous membranes tending to superficial ulceration. The microscope reveals branching columns of epithelial cells extending from the papillae of the skin into the deeper structures. "Cell-nests" are frequent. Involvement of the lymphatic glands is less marked than in the remaining forms of carcinoma.

**Cylindric epithelioma.**—Found in gastro-intestinal tract and in uterus. They are composed of acinus-like tubular structures, frequently composed of a number of layers of epithelium, the outer layer often being distinctly columnar. Later on, the acini become filled with epithelial cells of various shapes and the cylindric character is lost. They more nearly resemble the glandular cancers in their general characteristics than does the squamous variety.

**Treatment.**—Thorough excision of the involved tissue wherever found. If a squamous epithelioma is local beyond doubt,

and there be no lymphatic involvement (as in rodent ulcer), the growth may be destroyed by Michel's or Bougard's paste.

**Describe palliative treatment of malignant tumors of the mouth.**

The palliative treatment of malignant tumors of the mouth consists in keeping the buccal cavity as aseptic as possible by means of antiseptic mouth-washes. Local anesthetics (cocaine, menthol) are employed. Morphine is administered, and in some cases it has been advised to divide the lingual nerve. If the case is one of sarcoma, Coley's fluid may be tried. The X-ray is a recent addition.

**Give the treatment of a case of non-union in fracture of the inferior maxilla.**

Make incision along lower border of the body of the jaw, expose fragments, remove any intervening tissue, freshen edges, and wire together. In some cases it may suffice to rub the ends of the fragments together and then apply a Hammond splint.

**Give treatment of a lacerated wound.**

If the wound can be thoroughly cleansed and the edges have not been markedly contused, such a wound should be sutured and a wet bichloride dressing applied. If the wound cannot be thoroughly cleansed or if the edges are contused, clean the wound as thoroughly as possible, irrigate with a bichloride solution (1-2000), and apply warm antiseptic fomentations until all sloughs have separated. The wound should then be treated like any granulating surface.

**What is arthritis? Give treatment.**

By arthritis is meant an inflammation of a joint which involves all the structures of which it is composed.

Treatment of Acute Arthritis.—In early stage, elevate the limb, immobilize absolutely, and put in such position that, if ankylosis occurs, the part will be of some use to the patient. Fomentations or an ice-bag may also be applied. As soon

as symptoms of approaching suppuration appear, open joint freely in one (or better two) places, and wash out with some sterile or antiseptic solution (normal saline solution or sublimate 1-8000). Maintain fixation, continue irrigation until all symptoms of inflammation have disappeared, and look after the general health. If ankylosis occurs in a faulty position, resection of the joint may be required.

**How would you arrest hemorrhage from the tongue?**

Hemorrhage from the tongue may be arrested by exposure to the air, by ice, hot water, ligation, suture, and the cautery.

**Give etiology and treatment of false ankylosis.**

Etiology.—Inflammation outside of the joint, disuse.

Treatment.—Where inflammation has been cured, massage and passive motion, the alternate hot and cold douche, and graduated exercise. If due to disuse, exercise, massage and galvanism.

**Define neuritis. Give cause and treatment.**

By neuritis is meant the inflammation of a nerve.

Causes.—Inflammation, exposure to cold, some abnormal condition of the blood induced by rheumatism, chronic alcoholism, diabetes, etc.

Treatment.—Keep part at rest. Apply blisters along the course of the nerve. The administration of small doses of bichloride of mercury is sometimes of benefit. Treat any local cause or constitutional dyscrasia. It may be necessary to control pain by hypodermatic injections of morphine.

**When should a sequestrum be removed?**

A sequestrum should be removed as soon as it has separated. If the sequestrum is central (as in inferior maxilla), it should be left until the involucrum becomes sufficiently strong, the case meanwhile receiving appropriate antiseptic treatment. In such an instance, etc., the sequestrum acts as a splint.



**Define asphyxia. Give treatment.**

Asphyxia is suffocation. The suspension of vital phenomena which results when the lungs are deprived of oxygen.

Treatment.—Remove any local cause. If impossible to remove cause (in the larynx, for example), quickly perform tracheotomy below obstruction. After obstruction is removed or circumvented, artificial respiration is always indicated. If no local obstruction, artificial respiration from beginning; strychnine, atropine, or probably cocaine should be given by an assistant while the operator is performing artificial respiration.

**How should chloroform be administered? Ether? What accidents may occur? Give treatment.**

Chloroform should be administered in free admixture with air (chloroform vapor 5%, air 95%).

Ether should also be administered by the open method (ether vapor 95%, air 5%).

Accidents.—Death from cardiac or respiratory paralysis, mechanical asphyxia, congestion of brain, or by the entrance of vomited material into the larynx.

Treatment.—Failure of respiration is treated by withdrawal of anesthetic, clearing out throat and pulling forward of tongue, the performance of artificial respiration, the exhibition of pungent aromatics (ammonia), the hypodermatic injection of strychnine, atropine, or cocaine, the alternate douche of hot and cold water, and the use of the "electric brush."

Failure of circulation.—Withdraw the anesthetic, invert the patient, give hypodermatic injections of whisky and strychnine, and perform artificial respiration, clearing out the mouth and holding the tongue forward.

**Describe the operation for removing calculi from the salivary duct.**

The calculus is located by means of a probe and the palpating finger; the duct is incised and the calculus removed.

If the calculus is situated in the substance of the submaxillary gland, total removal of the gland may be necessary. In some cases the calculus may be seen projecting from the main duct of a gland, in which case it may be removed without incision.

**How are the wounds of arteries classified?**

Incised, lacerated, contused, punctured, poisoned, and gunshot.

They are sometimes divided into those in which the artery is completely divided and into those in which the artery is only partially divided.

**What is the difference between a traumatic and a congenital dislocation?**

A traumatic dislocation is one produced by the application of external violence and muscular force, acting alone or in combination.

A congenital dislocation is a malformation of a joint which exists at birth.

**Describe Gibson's bandage.**

The roller should be two inches in width and six yards in length. The initial extremity of the roller should be placed upon the vertex of the skull in a line with the anterior portion of the ear; the bandage is then carried downward in front of the ear to the chin, passed under the chin, and carried upward on the same line until it reaches the point of starting. The same turns are repeated until three complete turns have been made. The bandage is then continued until it reaches a point just above the ear, where it is reversed, carried backward around the occiput, and continued around the head and forehead until it reaches its point of origin; these circular turns are continued until three turns have been made. When the bandage reaches the occiput, having completed the third turn, it is allowed to drop down to the base of the skull, and it is then carried forward below the ear and across the chin, being brought back upon the opposite

side of the head and neck to the point of origin; these turns are repeated until three complete turns have been made, and upon the completion of the third turn, the bandage is reversed and carried forward over the occiput and vertex to the forehead, and its extremity is here secured with a pin. Pins should also be applied at the points where the turns of the bandage cross each other.

**Give the etiology, diagnosis, and treatment of tetanus.**

Etiology.—The infection of a wound with the bacillus tetani. It is more common in hot climates, in dark-skinned races, and in those who are employed about stables. Hygienic errors favor development, particularly the overcrowding of sick and wounded in a limited space.

Diagnosis.—Trismus, opisthotonos, emprosthotonos, or pleurosthotonos. The spasms are tonic in character with clonic exacerbations. Constipation and retention of urine are present. The mind is clear, there is a hypersecretion of sweat, and little or no fever. It may be possible to discover the source of infection.

Treatment.—Preventive treatment consists of applying the principles of antisepsis to every wound encountered.

Local treatment.—Antiseptic treatment of wound.

Symptomatic treatment.—Chloroform during the exacerbations of the spasm and chloral between the exacerbations. The introduction of food into the stomach by stomach-tube, and the evacuation of the rectum and bladder at regular intervals. Calabar bean has been highly recommended.

Specific treatment.—The administration of the antitoxin, which is best done by trephining and introducing it beneath the dura mater. The results obtained in man are anything but promising.

**What is pyorrhea alveolaris? Give the etiology and treatment.**

Pyorrhea alveolaris is an inflammatory condition of the margins of the gums, accompanied by a muco-purulent dis-

charge, which arises from pockets or pouches extending for a greater or less distance along the roots of the teeth.

**Etiology.**—Gout, uric acid, diabetes, certain conditions of diet, and irregularities of the teeth might be mentioned as predisposing factors. It is always preceded by an excessive deposit of tartar, beneath which bacterial infection occurs.

**Treatment.**—Removal of tartar and application of astringents and antiseptics, preferably peroxide of hydrogen. These applications must be made to all parts of the pouches or pockets. Sulphuric acid has been recently recommended. The treatment is prolonged and tedious. In many cases the teeth have been sacrificed. •

**Define a cyst. Mention three divisions of cysts and give the etiology and treatment of one division.**

By a cyst is meant a more or less rounded cavity with a distinct lining membrane, distended with some fluid or semi-solid material.

1. Cysts formed by the distension of pre-existing spaces.
2. Cysts of embryonic origin.
3. Cysts of new formation.

**Etiology.**—Dermoids may be due to the persistence of epithelial cells, in the deeper tissues, in situations where fleshy segments coalesce during fetal life. They may also be due to the persistence of certain tubular canals (thyro-glossal duct, post-anal gut).

Cysts of embryonic origin (dermoids) are to be removed by careful dissection.

**What are aseptic wounds? Describe an aseptic wound.**

Aseptic wounds include all which are preserved from contamination by poisonous bacterial products, whether such poison come in contact with the wound directly or be generated in it by the action of germs that gain access to it.

In an aseptic wound the process of healing is undisturbed, union occurs by first intention, there is no suppuration and no visible sign of inflammation.

**How should a penetrating wound of the temporo-maxillary articulation be treated?**

If the wound is small and there is reason to believe that it was made by an aseptic instrument, the skin should be thoroughly cleansed and an antiseptic dressing applied. A careful watch is then kept upon the condition of the joint and the temperature of the patient; as soon as signs of acute arthritis manifest themselves, free incisions are to be made into the joint, so as to relieve tension and allow of irrigation.

If the wound was inflicted by a dirty instrument, the wound should be enlarged, if necessary, so that its depths may be carefully examined and thoroughly cleansed. The cavity should be irrigated and drainage inserted. If acute arthritis supervenes, it must be treated in the usual way.

**Where are salivary calculi most frequently found?  
Give treatment.**

Salivary calculi are most frequently found upon the necks of the teeth opposite to the salivary ducts and in the duct of Wharton.

Treatment.—Removal and the regular use of Philipp's milk of magnesia. If protruding from orifice of the duct, they may simply be extracted. If within the duct, they should be cut down upon and removed.

**How should a salivary fistula be treated?**

This affection practically always occurs in relation to Stenson's duct. If the buccal portion is involved, the duct may be slit up from within the mouth. If the masseteric portion is wounded, a fine probe should be passed into the duct (from the mouth) as far as the fistulous opening, and then brought out at this orifice. A double thread of silk is now tied to the end of the probe and drawn through the thickness of the cheek, along the buccal portion of the duct, and out of the external wound. A fine drainage tube is then carried along the same tract, and left to project both externally and internally. A silk thread is attached to each end of the tube



and knotted around the angle of the mouth. In this manner a passage is re-established into the mouth, and as soon as it becomes easier for the saliva to travel along this than through the external wound, the fistula will close. The outer half of the tube may be removed in a few days, and only a thread allowed to remain in the external wound, which gradually contracts so that more and more of the saliva finds its way to the mouth. The silk thread and tube are finally removed, and, if the canal remains patent, the external wound soon heals. If the buccal portion of duct is obliterated so that the probe cannot be introduced, the thread and tube may be passed through all of the tissues of the cheek by means of a trocar and canula. The subsequent steps are similar to those of the previous method.

#### **How should hemorrhage from the gums be treated?**

By means of hot water, cold, compression, peroxide of hydrogen, styptics, suprarenal extract, or the actual cautery. If due to scurvy, appropriate antiscorbutic treatment; if due to hemophilia, calcium chloride gr. xxx t. i. d. and apply fibrin ferment, suprarenal extract, or cocaine, locally.

#### **Define necrosis. Give its diagnosis and treatment.**

By necrosis is meant the death of bone en masse.

The diagnosis is made by the presence of a sinus, the history of a preceding inflammation, and the results obtained by probing. Dead bone feels rough and hard; the probing is not painful nor is it followed by bleeding.

Treatment.—Early in necrosis, endeavor to moderate inflammation upon which the affection depends and open any abscesses that may form. During the time occupied by the loosening of the dead bone, no operative treatment should be instituted, as a rule, but attention should be given to the general health. As soon as the necrosed portion has become detached, it should be removed.

**What is a dislocation? Name the varieties, and give the causes.**

A dislocation is a displacement of one or more bones of a joint from its natural position. It is also the displacement of any organ from its natural position.

Traumatic.—Due to violence or muscular action.

Pathologic.—Due to disease.

Congenital.—Due to an error of development as a result of which a normal location of the bony constituents has never been present. (The term congenital “dislocation” is really a misnomer—it is a congenital malformation.)

**What is an incised wound? Give the prognosis and treatment.**

An incised wound is one made by any sharp-cutting instrument.

Prognosis.—Nearly always favorable, but depends upon the region involved and asepsis of the wound.

Treatment.—Arrest hemorrhage. Render the wound as aseptic as possible. Unite the edges of the wound by means of sutures and apply a septic dressing.

**Give diagnosis and treatment of caries.**

The symptoms of caries are those of osteitis complicated by an abscess leading to the softened bone. When caries is primary, it particularly involves the cancellous tissue (ends of long bones, flat bones). The pus from carious bone contains an excess of phosphate of lime.

Treatment.—If syphilitic, give potassium iodide; if tubercular, cod-liver oil with iodide of iron. Secure best hygienic surroundings. In early stages while the disease is advancing, keep the parts clean and free from irritation. When acute symptoms have subsided, an attempt may be made to remove the diseased bone by applications of iodine or of the mineral acids. If the carious bone can be reached from the surface, it may be removed with a gouge or with a burr-head drill. If

the disease is extensive, excision may be required. In some cases amputation is necessary to prevent fatal exhaustion.

**How may general infection be caused by oral operations?**

The wound in the buccal cavity may become infected by any of the micro-organisms found within the mouth. From this local source, the bacteria, their products, or both, may pass into the general circulation.

**Give the symptoms and treatment of acute suppurative periostitis.**

If the bone is superficial, there will be all of the symptoms and signs of inflammation. If the bone is deep, redness, swelling, and heat may not be observed over the inflamed area, on account of the density of the periosteum. The pain is of a most intense, aching character, worse at night, and greatly increased by pressure or by a dependent position of the part. If swelling is present, it is brawny in character and subsequently becomes red, edematous and softened in the center. If the abscess has opened spontaneously or has been incised, bare bone is exposed, the greater portion of which usually dies. This dead bone is either absorbed (if very small in amount) or cast off as a sequestrum.

Treatment.—A free aseptic incision down to the bone at the earliest possible moment. Antiseptic dressing. If necrosis has occurred, it must receive appropriate treatment. Supporting or antidiathetic treatment constitutionally.

**Give the differential diagnosis between syphilitic and aphthous ulceration.**

Syphilitic ulcers occur in the shape of cracks or fissures upon the sides or tip of the tongue, or upon the cheeks and lips. They are common in the secondary period of the disease. Papular eruptions of the skin and mucous patches may also be observed. These ulcers respond to anti-syphilitic treatment.

Aphthae commence as small blisters, which run a rapid course and are accompanied by slight salivation. The ulcers

are superficial, sharply outlined, multiple, and are situated not only upon the tongue, but particularly upon the cheeks and lips.

**Give the etiology and symptoms of the congenital malformation known as cleft palate.**

Etiology.—Failure of the palatal processes to unite.

Symptoms.—Inspection reveals a cleft in the median line. If the palatal process of one side has united with the ethmo-vomerine septum, a cleft slightly to one side (usually to the left) of the median line is observed. Since the union of the palatal processes takes place from before backward, it is rare to have a cleft of the anterior portion of the palate without the posterior portion being also involved. As a rule, there is considerable impairment of nutrition, from interference with deglutition. The exposure of the nasal mucous membrane leads to the formation of scabs which undergo putrefactive changes, producing a condition somewhat resembling ozaena. When the child learns to talk, articulation is frequently so indistinct that it is difficult to understand, and the voice has a peculiar and characteristic intonation. The so-called explosives (whether dentals, labials, or gutturals) which require a certain amount of air-pressure within the mouth for their proper pronunciation, are difficult to produce. This is particularly to be observed in the letters b, d, p, t, g and f.

**Give the diagnosis and treatment of trismus caused by impacted third molar.**

Diagnosis.—There is a partial or complete inability to open the jaws. Inspection reveals the impaction of the third molar. Necrosis may be present.

Treatment.—Relief of the impaction, either by extraction of the offending tooth or of the second molar. If necrosis is present, it must be treated upon general principles.

**Mention the most reliable agent for the destruction of micro-organisms. How should it be used?**

Heat.—It may be used in the form of dry heat or moist

heat (steam, under pressure if necessary, hot water). It should penetrate to the center of the material to be sterilized.

**What diseases of the tongue may be caused by diseased teeth?**

Traumatic ulceration, glossitis, abscess, and epithelioma.

**Describe the preparation of the oral cavity for an aseptic operation.**

Asepsis, as applied to the oral cavity, is but a relative term. All cavities in the teeth should be cleansed, disinfected and filled. The interstices between the teeth must be carefully cleansed and the mouth repeatedly washed out by a boric acid solution as hot as can be borne. The nasal cavity should also be rendered as aseptic as possible, and the patient should gargle repeatedly with hot boric acid solutions.

**Define a multilocular cyst.**

A multilocular cyst is one which is composed of a number of loculi or chambers.

**Describe treatment and appliance for acquired cleft palate.**

Acquired perforations of the palate are usually due to syphilis, but lupus and traumatism are also occasional causes. Treatment should first be directed to the underlying cause. When inflammatory symptoms have subsided and nature has done all she can to repair the defect, the local treatment is indicated. If the perforation is small, an attempt may be made to close it by freshening the edges of the perforation, dissecting up muco-periosteal flaps and suturing them together. This will rarely be practicable, however, and in the great majority of cases an obturator or an artificial velum must be introduced.

An obturator is a plate which is so adjusted as to close the perforation. It should never be made in the form of a plug, since the opening may be enlarged by the constant pressure and irritation. It is made of thin vulcanite or gold, and is



fixed to the teeth and held in position by suction. Intra-nasal projection will sometimes improve the quality of the articulation by diminishing the size of the nasal cavity.

An artificial velum is a plate obturator, to the posterior portion of which a hinged segment is attached, to take the place of the normal velum. This hinged segment may rest upon the nasal side of the soft palate. A thin rubber bag, filled with air and sewn to the posterior portion of the obturator, is sometimes used in place of the hinged segment. Artificial vela are by no means so satisfactory, as a rule, as are the plate obturators.

**Define odontalgia. Give the etiology and treatment of odontalgia.**

Toothache.

It may be caused by many different pathologic conditions of the tooth or surrounding tissues, such as congestion of the pulp, exostosis of the roots, pulp nodules, mechanical or chemical irritation, reflected pains from irritation of areas supplied by other branches of the fifth nerve (impacted body in external auditory meatus, etc.), infection, mal-occlusion, exposure of dentine and denudation of roots.

Treatment.—Removal of the cause. In the majority of cases the pulp of the tooth must be removed. Tincture of iodine to the gums and chloroform or oil of cloves to cavities in teeth, might be mentioned as temporary measures.

**Describe (a) Sylvester's method of producing artificial respiration; (b) Laborde's method of producing artificial respiration.**

(a) Sylvester's method.—The patient is placed upon his back with a folded coat or a pillow beneath the interscapular region, the throat is cleared of mucus, the tongue held well forward, and all constricting clothing removed from throat and abdomen. The operator kneels or stands behind the patient. The forearms are grasped near the fully-flexed elbows and the lower portion of the thorax is compressed for

a few seconds by forcing the patient's elbows against the thoracic wall. The arms are then moved outward and upwards until the hands cross over the head. This secures elevation of the costal walls and simulates inspiration. The arms are kept in this position for a few seconds and then brought downward to the first position, pressure being made upon the costal walls with the elbows of the patient. This stimulates expiration. These movements are to be repeated from twelve to fifteen times a minute.

(b) Laborde's method. — After clearing the throat of mucus, rhythmic traction is made upon the tongue.

**Describe the effect of arsenic upon the pulp of a tooth.**

The pulp becomes devitalized and there is an absence of the previously existing sensibility, as may be demonstrated by the use of any exploring instrument.

**State the pathologic changes in chronic inflammation.**

Dilatation of blood-vessels, slowing of current, exudation of fluid, transmigration of leucocytes and multiplication of the pre-existing connective tissue cells of the part. The only difference between acute and chronic inflammation is one of degree. In chronic inflammation the productive changes are much more marked than the exudative or the degenerative ones.

**Describe the healing of wounds, irrespective of the anatomic structure of the tissue involved.**

The healing of an aseptic wound will be described. There is a certain amount of exudation, resulting in the formation of fibrin, which temporarily binds the lips of the wound together. This network of fibrin serves as a framework for the leucocytes and multiplied connective tissue cells. The exudate becomes vascularized, and is then known as granulation tissue. The leucocytes have nothing to do with the building up of tissue. They destroy the fibrin network and then either return to the circulation or are fed upon by the connective tissue cells or fibroblasts. The fibroblasts soon become spindle-

shaped, and their ends become split up into primitive fibrillæ. This conversion of the round fibroblasts into the connective tissue fibre results in the contraction of the cicatrix, which binds the lips of the wound tightly together.

**Define contusion, luxation and fracture.**

A contusion is a subcutaneous laceration of the tissues.

A luxation is a displacement, as regards their relative position, of the bones which enter into the formation of a joint.

A fracture is a solution of continuity of bone, produced by violence.

**Name two forms of tumors which may involve the tissues of the face or jaws. State whether benign or malignant, and briefly outline surgical treatment.**

Epithelioma, sarcoma.

Both of these tumors are malignant.

The treatment consists of the thorough removal of all of the affected tissues. If a complete operation cannot be performed, the treatment is simply palliative.

**Name three congenital deformities of the oral tissues which affect the speech. Briefly outline the surgical treatment of each.**

Macroglossia, hare-lip, and cleft palate.

Macroglossia is best treated by removing a V-shaped piece of the tongue, with the apex directed backward, and uniting the resulting wound by sutures.

Hare-lip is treated by paring the edges of the cleft and bringing them together by sutures. The depth of the lip should be increased to allow for subsequent contraction.

Cleft palate is treated by paring the margins of the cleft, together with its anterior angle, elevating the two lateral flaps of mucoperiosteum and uniting them in the median line by sutures. Lateral incisions are made if it is necessary to relieve tension.

**Give the causes of antral empyema.**

The extension of inflammation from carious teeth, direct

violence applied over the cavity, an injury to the alveolar process which opens the antrum, and the extension of a suppurative process from the nasal cavity.

**Differentiate between fracture and dislocation of the mandibular condyle.**

In fracture of the neck of the condyle, the condyloid fragment is drawn forward and inward by the external pterygoid muscle and the body of the bone is displaced toward the opposite side, somewhat simulating a dislocation. The mouth is closed, however, and any attempt to open it produces pain and generally crepitus. The deformity recurs almost immediately after reduction unless the fragments are held in apposition.

In dislocation of the mandibular condyle (unilateral dislocation of the jaw) the mouth is open and cannot be closed. The chin is directed toward the sound side. Upon external palpation the condyle can be felt in front of its normal position, which is the site of a vacuity; upon internal palpation the coronoid process may be felt in an advanced position. Crepitus is absent and the deformity does not recur after reduction as long as the mouth is kept closed.

**a. Describe tic doloureux. b. Why is it of special interest to the dentist? c. What surgical operations are practiced for its relief?**

a. Tic doloureux or trifacial neuralgia is characterized by severe paroxysmal pain in the region supplied by one or more of the divisions of the trifacial nerve and is not associated with structural changes in the nerve.

b. Tic doloureux is of special interest to the dentist because it may simulate affections of the teeth, of the alveolar process, or of the maxillary antrum.

c. The surgical operations practiced for its relief are neurectomy of the affected branch of the fifth nerve, excision of the nerve and plugging the particular canal, removal of Meckel's ganglion, and removal of the Gasserian ganglion.

**Give the diagnosis of ranula.**

A ranula is a cystic swelling in the floor of the mouth generally to one side of the median line. It is translucent and bluish in appearance and is covered with thin healthy mucous membrane. The fluctuating mass may push up the anterior portion of the tongue and interfere with deglutition and articulation. Inflammatory symptoms are absent. Puncture reveals a glairy viscid fluid somewhat resembling saliva.

A dermoid cyst in this region usually involves the tongue to a greater or less degree, is more deeply placed than a ranula, and is more apt to project and give fluctuation in the submaxillary region.

**Differentiate between dislocation and double fracture of the lower jaw.**

In bilateral dislocation, the mouth is wide open and cannot be closed. Upon both sides there is a vacuity in front of the tragus and the condyle may be palpated in an advanced position; palpation from within the mouth reveals an anterior displacement of the coronoid processes. The chin is carried forward and downward so that face seems to be elongated.

Double fracture is characterized by loosening and irregularity of the teeth, preternatural mobility, crepitus, and dribbling of bloody saliva. The central fragment is displaced downwards by the suprahypoid muscles.

**Name and describe the surgical operation for cleft palate.**

The operation proposed by Brophy, of Chicago, promises to revolutionize the treatment of cleft palate.

He prefers operating at the third month. Observing all antiseptic detail, the mucous membrane at the margin of the cleft is divided and all of the soft tissues are elevated from the hard palate, including the periosteum. The edges of the cleft are then pared throughout the entire length of the soft palate and the membranes at the distal surface of the horizontal plates of the palate bones are divided. This allows the



soft parts to fall together and obviates the necessity of making lateral incisions into or through the palate. Four tension sutures of silver wire No. 22 are now introduced and their extremities are passed through lead plates. These lead plates (No. 22 American gauge), are perforated with holes, corresponding to the number of sutures, and extend from the anterior margin of the fissure to the distal border of the soft palate and are moulded to conform to its shape. Before the lead plates are fixed in place, coaptation sutures of silk are introduced into the margins of the cleft but are not tied until the edges of the cleft have been approximated by the tension sutures and lead plates. Immediate union should be secured.

If the patient is older and the bones have commenced to harden, Brophy thoroughly removes the edges of the fissure and trims the opposing edges of the bones. The cheek is then raised and a strong special needle threaded with a large braided silk ligature is passed through the substance of the bone to the central fissure. The needle is introduced just back of the malar process and high enough to insure its passage above the palate bone. An opposite needle now carries a corresponding suture through the opposite side, one loop is threaded into the other, and one loop may thus be carried through both maxillary bones. Silver wire No. 20 is now threaded into the loop of silk and drawn through both bones. In a similar manner a second wire suture is passed nearer the anterior portion of the maxilla above the palatal plate. Two lead plates (No. 17 American gauge) are now made to fit the buccal convexity of the bone and are perforated for the reception of the silver sutures. Upon each side the posterior suture is twisted with the anterior suture until the bones are approximated. If the bones do not come together a horizontal section of the malar process is made upon each side, when the bone can be readily moved toward the median line. Any irregularities of the cleft may be closed by a few coaptation sutures of silk, but this is not usually necessary.

**a. How is a simple cyst in soft tissues differentiated**

from other tumors? **b. What surgical measures are necessary to prevent its recurrence?** **c. Are cystic growths classified as benign or malignant?**

*a.* A cyst is characterized by an absence of inflammatory symptoms, unless it is inflamed. Fluctuation is present and the hypodermatic needle reveals a non-purulent fluid. A superficial cyst can be better outlined than is the case with an abscess.

*b.* The complete removal of the cyst wall.

*c.* Cystic growths are classified as benign.

**a. Give diagnosis of necrotic alveolar process.** **b. What important condition of the diseased bone should be determined before operating?** **c. Outline the operation.**

*a.* There will usually be one or more sinuses which lead down to sequestra. Necrosed bone can be readily recognized by the hard and rough sensation communicated by the probe.

*b.* No operation should be performed until the sequestrum has become detached.

*c.* Make an incision down to the bone in the line of the principal cloacae. Two or more of these are united by sawing through the invaginating bony tissue with a Hey's or Gigli saw and the sequestrum is freely exposed. The sequestrum may now be withdrawn entire, or, if necessary, sawn in two and each half extracted separately. The cavity should be thoroughly irrigated and packed with antiseptic gauze.

**a. In a case of accidental obstruction of the glottis with strangulation and death impending, what should be done to save the life of the patient?** **b. Give details of procedure.**

*a.* Tracheotomy.

*b.* The patient is placed in the dorsal position with the head extended and held in such a position that the median line of the face will correspond to the median line of the neck. An incision about two inches in length is made in the median line, from below upward, and terminating at the thy-

roid cartilage. This incision divides the skin and superficial fascia. The anterior jugular veins, lying to either side of the median line, should be avoided by cutting between them and drawing them aside. The deep cervical fascia is next divided, the interval between the pretracheal muscles recognized, and the wound deepened by blunt dissection. The pretracheal fascia is now divided and the isthmus of the thyroid gland drawn downward. After hemorrhage has been checked and the tracheal rings exposed, the trachea is steadied (by a tenaculum if possible) and two or three rings are divided from below upward. The edges of the tracheal wound are then held apart. The wound and surrounding area should now be rendered as aseptic as possible, a suitable tracheotomy tube procured and inserted, and an antiseptic dressing applied.

**What facial and oral tissues are usually attacked by epithelioma?**

The lip and the tongue are the parts most commonly affected, but any portion of the epithelial surface (such as the gums or the buccal parieties) may be attacked.

**How may a foreign body be removed from the posterior nasal passages when lodged beyond the reach of tweezers or forceps? Example—a grain of corn, bead, or button.**

The foreign body can generally be pushed down into the pharynx by a probe introduced into the anterior nares. Care should be taken that it is not inhaled into the larynx or trachea or swallowed.

In some cases it may be possible to dislodge it by the use of the Politzer bag or by syringing. Sajou's method may be tried—it consists of drawing a cotton or wool tampon through the nasal passage from behind. It may be necessary to first break up the foreign body by drilling.

**What is the treatment for the relief of empyema of the antrum when the teeth are sound and in place?**

The establishment of efficient drainage and thorough irrigation of the cavity of the antrum. A sufficiently large open-

ing should be made in the anterior wall of the antrum in the region of the canine fossa. The cause of the disease should also receive appropriate treatment.

**Give the etiology and characteristics of suppurative inflammation.**

From a clinical standpoint all suppurative inflammations are due to the presence of pyogenic bacteria, which may gain access to the affected part through a wound or through the circulation.

When an inflammation terminates in suppuration, the pain is at first dull and aching, and then assumes a throbbing character. The hard and brawny swelling becomes soft and fluctuating in the center and the overlying skin is edematous. The swelling also becomes more localized than in simple inflammation and the redness assumes a dusky hue. The constitutional symptoms of impending suppuration are the occurrence of a rigor or merely a sensation of chilliness, sweating, and a sharp rise of temperature.

**Describe the intermittent pulse, the thready pulse, and the hard pulse.**

An intermittent pulse is one in which a beat is occasionally missing while the pulse, in the intervals, is perfectly regular.

The thready pulse is one of low tension and the artery can be palpated only during the beat.

The hard pulse is one of high tension and the artery is full between the beats and can be rolled beneath the finger.

**Mention the disinfecting lotions used for surgical irrigations.**

Solution of bichloride of mercury (1-4000) and of carbolic acid (1-100) are the ones usually employed. Mention might be made of lysol, creolin, salicylic acid, boric acid, hydrogen peroxide, potassium permanganate, oxalic acid, and chlorin water.

**State what the elevation of the body temperature dur-**

**ing the treatment of fractures of the maxillae indicates. Give treatment.**

If the rise of temperature is not marked it is simply a concomitant of the healing process and requires no special treatment. If the fracture is compound the most rigid asepsis possible should be observed.

A considerable rise of temperature accompanied by a rigor or a chilly sensation and throbbing pain indicates the formation of pus. The treatment would naturally consist in the evacuation of the pus, free drainage and the maintenance of the parts in as aseptic a condition as possible.

**Give the etiology, pathology, and treatment of chronic alveolar abscess.**

Practically all cases of alveolar abscess are due to carious teeth.

The pathology is that of any chronic abscess in bone. First we have an osteitis and the inflammatory exudate, instead of becoming vascularized and converted into new tissue, breaks down; its cells perish from malnutrition, degeneration occurs, and suppuration is the result.

While the abscess may be reached through the alveolus, the best method is to extract the tooth, thus removing the original cause and securing drainage. In obstinate cases the abscess cavity should be curetted and packed with iodoform gauze. If a fragment of necrosed bone is present it must be removed to secure closure of the sinus.

**State the method of arresting hemorrhage from the inferior dental canal.**

By plugging the bleeding-point with Halsted's "gut wool," or with Horsley's antiseptic wax (beeswax seven parts, almond oil one part, and salicylic acid one part).

**Give the etiology, diagnosis, and prognosis of carcinoma of the mucous membrane of the buccal cavity.**

The etiology of carcinoma of the buccal mucous membrane is as obscure as is that of carcinoma in general. A predis-



posing cause may be furnished by continual irritation such as the edge of a carious tooth or the taking of hot foods or undiluted spirits.

The affection may commence as an ulcer or fissure, as a papilloma, or as a nodule, but in nearly all cases it is characterized by the early occurrence of ulceration and the ulcerated surface is surrounded by an indurated everted margin. Pain is not present early in the disease, but may prove a valuable factor in the diagnosis. The neighboring lymphatic glands may be involved. The age of the patient will usually furnish an additional aid.

The prognosis is guardedly favorable if the growth can be entirely removed. If a complete operation is impossible the prognosis is absolutely unfavorable.

**Mention the rules necessary for surgical cleanliness.**

The entire field of operation, and the hands of the operator should be rendered as aseptic as possible.

The instruments, sponges, sutures, ligatures and everything coming in contact with the wound should be sterile.

Free drainage should be provided if much exudation is expected in the wound.

After the operation the wound should be kept as aseptic as possible either by sterile occlusive dressings or by irrigation with antiseptic solutions according to the exigencies of the case.

**Describe (a) a quick pulse; (b) a feeble pulse; (c) an irregular pulse. State what each indicates.**

(a) The term "quick pulse" is ambiguous. According to Broadbent, the word quick is capable of two applications in this connection since it may apply either to the rate at which the beats follow each other or to the character of the individual beats. A "quick pulse" may consequently mean either a frequent pulse or one in which the individual pulsations are of short duration. A frequent pulse may be due to septic infection. A pulse in which the individual beats are of short duration is due to diminished intervascular tension.

(b) A feeble pulse is one that is weaker than normal and usually indicates cardiac insufficiency.

(c) An irregular pulse is one in which the beats follow each other at regular intervals and are unequal in force. If of occasional occurrence it indicates reflex disturbance of the cardiac rhythm, gastric derangement with or without flatulence, or other functional affections. If permanent in character it may indicate cardiac disease, affections of the respiratory organs, or the abuse of tobacco, tea, &c.

**Describe the operation of removing a benign tumor.**

A lipoma of the back will be selected as an example. After all aseptic precautions have been observed, an incision is made over the tumor extending down to its capsule. The fatty tumor and its capsule are then enucleated, usually by blunt dissection, all hemorrhage checked, the edges of the wound are united by sutures, and an aseptic dressing is applied.

**Describe the operation of removing a malignant tumor.**

We operate just as in the case of the benign growth but the incisions must be carried wide of the tumor and well into the surrounding healthy tissue. If neighboring lymphatic glands are involved they must be removed in continuity with the growth and no incision is to be made across the intervening lymphatic channels. The primary object is the complete removal of the tumor and the closure of the wound is of secondary importance. If a great deal of skin must be sacrificed the wound may be closed by sliding one or more flaps over it or by skin grafting. A rigid aseptic technique should be observed.

**Give the etiology, clinical appearance, and treatment of smoker's patch of the tongue.**

Smoker's patch is the stage of chronic superficial glossitis which is known as leukoplakia. It is due to an inflammation of the mucous membrane causing an overgrowth of epithelium, which becomes heaped up into rough, dry, horny patches.

The inflammation may be caused by excessive smoking, the drinking of undiluted spirits, the ingestion of highly seasoned foods, syphilis, or a combination of several of these causes.

The treatment is unsatisfactory as far as cure is concerned. The exciting factor should be removed and the patch carefully watched for signs of commencing malignancy. The diet should be bland, sterile, and unirritating, and after each meal the teeth should be brushed and the mouth rinsed out with some mild antiseptic solution. No local applications should be made. Appropriate constitutional treatment should be instituted in syphilitic cases.

### **Differentiate shock and syncope.**

Shock may be defined as the immediate constitutional effect of an injury. "It is that state of general depression of the vital activity which occurs after severe injuries, especially where there has been violent stimulation of the peripheral nerves and nerve-endings, but may be induced also by some powerful impression applied to nerve centers" (Pick).

Syncope is a state of suspended animation, due to sudden failure of the heart's action, producing anemia of the brain. It may occur without injury and be produced by the emotions, intrinsic cardiac conditions, depression of the heart from hunger or exhaustion, or by a sudden loss of blood.

### **Differentiate carcinoma of the tongue and gummatous ulcer of the tongue.**

#### **Carcinoma.**

Always single.

Usually in the anterior half and at the side of the tongue.

Lymphatic glands usually involved.

Painful.

Induration follows ulceration.

Everted ragged edges.

#### **Gummatous ulcer.**

May be multiple.

Chiefly far back on the dorsum. Other syphilitic lesions may be present in the mouth.

Lymphatic glands rarely involved.

Painless.

Induration precedes ulceration.

Sharp-cut edges.

There may be a history of preceding chronic superficial glossitis.      History of preceding syphilis.

Patient usually past 40.

May be younger.

Does not improve on potassium iodide.

Improves rapidly on potassium iodide.

The microscope may determine the diagnosis in doubtful cases. Both carcinoma and gumma are much more frequent in males than females (5 to 1).

**Describe the symptoms of syncope that may occur during the administration of chloroform. Give treatment.**

Sudden cessation of the pulse, sudden dilation of the pupil, blanching of the face, and secondary failure of respiration.

Treatment.—Stop the anesthetic. Invert the patient. An assistant should administer a hypodermatic injection of ether followed by one of strychnine and the operator should commence artificial respiration as soon as possible, care being taken that the tongue is held well forward to allow the air to enter the lungs.

**Give the etiology, diagnosis, and treatment of ulcer.**

The causes of ulceration are either constitutional or local.

The constitutional causes all act by producing an impairment of vitality. These causes are senility, deficient innervation, and diseases which induce malnutrition such as scurvy, diabetes, tuberculosis, and syphilis.

The local causes are either interference with the circulation of a part or some irritation applied to a part.

Diagnosis.—An ulcer is a solution of continuity of the skin or mucous membrane due to molecular or particulate death of the part.

Treatment. — The constitutional treatment is that of the underlying disease or condition of malnutrition. It may be said in general that the local treatment consists of the removal of the cause and the maintenance of the ulcer in as aseptic a condition as possible; it will naturally vary with the particular variety of ulcer.

**Describe (a) a frequent pulse; (b) a soft pulse. State what each indicates.**

(a) A frequent pulse is one which beats more rapidly than that of the average healthy individual. It may be due to idiosyncrasy, the action of drugs, or almost any departure from a normal state of health.

(b) A soft pulse is one in which there is no increase of the intravascular tension. It may be felt in health.

**Give the etiology and treatment of acute infectious osteomyelitis of the inferior maxilla.**

Acute infectious osteomyelitis of the inferior maxilla may result from infection from without (as in a compound fracture) or from infection from within (hematogenous infection). Various micro-organisms may be responsible, such as staphylococci, streptococci, typhoid bacilli, and the bacillus coli communis.

The treatment should be early and energetic. It consists of making a large opening in the mandible and scraping out all of the diseased marrow. The medullary cavity should then be irrigated by strong solutions of bichloride of mercury (1-1000) and packed with iodoform gauze.

**State the complication that may arise from a compound fracture of the inferior maxilla. Give treatment.**

Acute infectious osteomyelitis. See answer to preceding question.

**Give the etiology, the pathologic anatomy, the constitutional symptoms, and the treatment of necrosis of the maxilla.**

Necrosis is practically always due to arrested circulation in the bone. This may result from injury, as when the periosteum is torn away in a compound fracture. In otitis the vessels may be compressed by the exudate in the Haversian canals and in acute periostitis and osteomyelitis the nutritive supply may be entirely destroyed and extensive necrosis re-



sult. Necrosis of the jaw may also occur from exposure to the fumes of phosphorus or as the result of mercury when given to excess.

**Pathologic Anatomy.**—Where the necrosis is due to injury and only the outer laminæ perish we speak of peripheral necrosis. If there is a limited inflammation of the cancellous tissue, usually tubercular, which leads to the death of a portion of the bone, as in chronic abscess, we speak of central necrosis.

If the entire thickness of the bone is destroyed, as in cases of panosteitis, the term total necrosis is applied.

The portion of dead bone is called a sequestrum. The periosteum surrounding a sequestrum deposits new bone and so forms an involucrum or invaginating sheath about the dead tissue. In this involucrum are a number of openings or cloacae which allow the pus to escape externally through sinuses in the soft parts. Where the periosteum has been torn away, resulting in peripheral necrosis, an invaginating sheath is not formed but the sequestrum is cast off by exfoliation.

The constitutional symptoms vary according to the amount of tissue involved and the nature of the infection. If the necrosis is peripheral the only constitutional symptom may be a slight rise of temperature; but if it be total, as in cases of acute osteomyelitis, the patient is violently ill, and chills, hyperpyrexia, and profuse sweating are observed.

The treatment consists of the removal of the sequestrum as soon as it has become loosened, the disinfection of the remaining cavity, and tamponade with iodoform gauze maintaining the parts in as aseptic a condition as possible and supporting the general health by appropriate measures. In cases of acute osteomyelitis, we do not wait for the sequestrum to form but clean out the medullary cavity at once as previously described.

**Give the etiology, the pathologic anatomy, and the microscopic appearance of acute local periostitis.**

Acute local periostitis is usually the result of injury, but

may also be due to extension of an inflammation from the surrounding parts (example periostitis of the jaw from alveolar abscess). It may also result from constitutional diseases such as tuberculosis or syphilis, and may follow acute rheumatism, typhoid fever, scarlet fever, or measles.

Pathologic Anatomy.—The periosteum is swollen and red; its deeper layers in particular are infiltrated by inflammatory exudate which accumulate between the periosteum and the bone. The swelling produced in this manner is known as a periosteal node.

The microscopic appearance is that of any acute inflammation. The vessels are distended and tortuous and the tissues are infiltrated with small round cells. If the disease has lasted some time areas of necrosis may be observed.

**Give the etiology and pathologic anatomy of caries of the maxillae.**

Caries is usually a tubercular affection but may be due to other conditions. It may occur upon the surface of a bone beneath a subperiosteal gumma. It may also be the result of a non-tubercular rarefying osteitis where the entire bony structure is absorbed and converted into granulation tissue.

Pathologic Anatomy.—As a result of hyperemia and the outpouring of an inflammatory exudate, the Haversian canals and trabecular spaces become crowded with granulation tissue which may show the characteristic structure of tuberculous disease. Some of these cells destroy the walls of the Haversian canals, forming the so-called Howship's lacunae. The cells situated within these lacunae are known as osteoclasts. The remainder of the granulation tissue undergoes caseation, and this form of caries is called *caries suppurativa*. When the granulation tissue destroys the bone and then becomes absorbed, instead of undergoing caseation, we speak of *caries sicca*. If the granulation tissue is excessive and the destruction of bone is rapid so that it fungates into a joint or beneath the skin, the name of *caries fungosa* is applied. In some instances the granulation tissue dies before it absorbs

and replaces the bone. In such a case a mass of bone may be cut off from its nutritive vessels and die en masse when we speak of *caries necrotica*.

**Describe the character of the pain in trifacial neuralgia. State the location of pain when each of the three divisions is affected.**

The pain of trifacial neuralgia is paroxysmal and may be burning, darting, or lancinating in character. The skin may be exquisitely tender, particularly at certain points along the course of the nerve, the so-called tender points. The pain may sometimes be preceded by a tingling sensation, and is usually limited to a certain group of nerves upon one side of the face. It may sometimes be relieved by pressure.

When the ophthalmic division is affected the pain is located in the forehead, orbit, and nose.

When the superior maxillary division is affected the pain is located in the lower lid, in the side of the nose, in the lip, in the upper jaw, in the roof of the mouth, and in the upper teeth.

When the inferior maxillary division is affected the pain is located in the ear, in the temporal region, in the lower jaw, and in the lower teeth.

**Give the symptoms and treatment of syphilitic periostitis. State the pathologic changes that may occur in syphilitic periostitis.**

In the early stages of secondary syphilis there may be aching pains in the superficial bones and their surfaces may exhibit swellings which are very tender to the touch. The temperature of the patient is slightly increased. This form of periostitis soon disappears under the administration of mercury, to which it is well to add some iodide of potassium, which generally relieves the pain immediately.

In the later stages of secondary syphilis a single periosteal node may appear upon one of the superficial bones. It is accompanied by aching pain, which is always worse when the

patient is warm in bed. The treatment consists of the administration of iodide of potassium.

The pathologic changes that may occur in syphilitic periostitis are caries, necrosis, the formation of gummata, and the formation of new bone.

**Give the etiology and symptoms of salivary calculus.**

Mixed saliva contains a certain percentage of calcium salts which are held in solution by carbon dioxid. Lactic acid fermentation is so common in the human mouth as to be almost a characteristic. This lactic acid coagulates the mucin; the calcium salts are precipitated by the escape of their solvent, carbon dioxide, and become entangled in the mucin coagulum. It is stated that coagulation of the mucin is not necessary to bring about this condition of affairs but that its inspissation is alone sufficient.

Symptom.—The calculi are found upon the surfaces of the teeth, particularly opposite the mouths of salivary glands; beneath the margins of the gums, and in the ducts of the muciparous salivary glands (sublingual and submaxillary). The symptoms in general are those of a persistent foreign body in contact with a vital tissue.

**Give the etiology, pathology, and treatment of acute alveolar abscess.**

Acute alveolar abscess is practically always the result of decayed teeth.

The most superficial variety is known as “gum-boil.” The deeper varieties commence at the apex of a decayed fang. The pus may perforate the alveolar wall (or pass over its edge) and form a localized collection beneath the periosteum, which may ultimately lead to necrosis of the jaw.

In the upper jaw the affection may cause empyema of the maxillary sinus or burrow along the hard palate; in the lower jaw it may point on the cheek or at the lower margin of the bone.

The treatment consists of removing the offending tooth and

establishing free drainage. In some cases drainage may be secured by drilling through the alveolar process, but it is not a satisfactory method in general, owing to the difficulty of locating the particular fang involved. In the very superficial forms of acute alveolar abscess the tooth may be saved.

#### **Give the etiology of acute arthritis.**

Acute arthritis may begin in the synovial membrane as a rheumatic synovitis, as a septic synovitis (from the introduction of septic material from without through a wound), or as an infective synovitis (from the introduction of organisms from within through the blood). It may also result from disease of the contiguous soft parts (as in suppurative bursitis, phlegmonous erysipelas) or from disease of the neighboring bones (as in the acute arthritis of infants).

#### **Give the treatment of aseptic wounds.**

Rest and the maintenance of asepsis by a sterile occlusive dressing.

#### **State the causes of irregularities of the teeth.**

Early extraction of deciduous teeth, delayed loss of deciduous teeth, early extraction of permanent first molar, and cleft palate.

#### **Give the etiology and clinical appearance of salivary fistula.**

Salivary fistula may be due to a wound of the cheek dividing Stenson's duct; the saliva escapes through the opening and prevents closure of the external wound. It may also result from an abscess of the duct caused by an impacted salivary calculus.

Clinical Appearance.—There is a fistulous opening in the cheek which is generally surrounded by a number of small granulations. Saliva flows through the fistula as soon as the patient commences to eat and produces excoriation of the surrounding skin.



**Give the etiology, diagnosis, prognosis, and treatment of chronic traumatic ulcers of the tongue.**

Chronic traumatic ulcers of the tongue are due to irritation from a jagged tooth, a mass of tartar, or the edge of a plate.

The diagnosis is made by the discovery of the exciting cause and the exclusion of the other varieties of ulceration. These ulcers are usually situated at the side of the tongue opposite the offending tooth; they are ragged and irregular.

If the ulcer has been present for a long time, slight induration may be observed. The glands are not enlarged. The diagnosis is confirmed by the healing of the ulcer after the removal of the local irritation.

The prognosis is favorable.

The treatment consists of the removal of the cause and the maintenance of the oral cavity in as aseptic a condition as possible.

**State how the different forms of heat may be applied in the treatment of inflammation. How does heat affect the white blood corpuscles?**

Dry heat may be applied by an india-rubber bag containing hot water; by a rubber tube or a Leiter's tube through which flows a stream of hot water; or by the application of a flannel bag containing hot salt.

Moist heat is applied by poultices or fomentations.

The ameboid movements of the white blood corpuscles of mammalian blood are increased by a temperature of 38° C. (100.4° F.). Considerable elevations of temperature destroy the white blood corpuscles.

**Give the etiology and treatment of cellulitis.**

Cellulitis may be due to infection with the streptococcus pyogenes, the bites of snakes, dissecting wounds, and to some animal poisons (as those of fetid urine extravasated into the tissues in cases of ruptured urethra).

The treatment consists of early and free incisions to afford

a ready exit for the effused products of inflammation. Warmth and moisture should be applied in the shape of antiseptic fomentations and the part should be kept at rest. The constitutional treatment should be supporting in character. The diet should be liquid and nourishing.

**Give the etiology and treatment of primary swelling in inflammation.**

The swelling in inflammation is due to the engorgement of the blood-vessels, to the exudation of the watery elements of the blood, and to the transmigration of leucocytes. In the so-called third stage of inflammation, this swelling is increased by the multiplication of the pre-existing connective tissue cells of the part.

The treatment consists of rest, position, the application of heat or cold, local depletion, and the other measures previously mentioned under the treatment of inflammation in general.

**State the effect of local bleeding upon inflamed tissues.**

Local bleeding depletes the inflammatory area, and consequently diminishes the amount of exudate by decreasing the intravascular tension.

**When does secondary hemorrhage occur? Give the treatment of secondary hemorrhage.**

At a later period than twenty-four hours after the accident or operation.

Preventive Treatment.—Thorough asepsis, the proper application of ligatures to all bleeding points, and the avoidance of the injudicious use of stimulants.

Curative Treatment.—This will depend upon whether the hemorrhage comes from the end of a divided artery (as in a stump) or whether it comes from an artery that has been ligated in its continuity. Much might be written under this head from a surgical standpoint; but as far as dentistry is concerned it suffices to say, in a general way, that the treatment consists in securing the blood-vessels by one or more

ligatures. In mild cases of secondary hemorrhage from the end of a divided artery, elevation, exposure to air, irrigation with hot sterile saline solution, and firm bandaging may be sufficient. If ligatures cannot be employed on account of the septic condition of the tissues, the actual cautery will be of service. All septic sloughs should be curetted away, and the wound swabbed out with carbolic solution (1-20) or with a solution of chloride of zinc (1-12). The wound should then be dusted with iodoform crystals, firmly packed with iodoform gauze, and a firm bandage applied.

**State the causes of arrest of development of the maxillary bones.**

Early extraction of deciduous teeth, early extraction of the permanent first molar, ankylosis of the temporo-maxillary articulation.

**Describe Angle's method of treating a fractured maxilla or mandible.**

Angle's method of treating a fractured maxilla or mandible consists of holding the jaws in fixed contact by means of wire ligatures wrapped in the form of the figure 8 around buttons attached to bands encircling suitable opposite or nearly opposite teeth.

This method is not based upon sound principles. A better result can always be obtained by wiring.

**Describe the treatment of a single fracture of an edentulous jaw when the patient has an artificial upper and lower denture.**

The upper and lower dentures are to be united (by soldering or vulcanization as the case may be) and used as an intermaxillary splint. The upper and lower central incisors are removed to facilitate the feeding of the patient and external support is furnished by a Barton bandage.

If the patient is a fit subject for anesthesia, such a fracture would be better treated by wiring the fragments together.

**Give the symptoms and treatment of tubercular periostitis.**

**Symptoms.** In the course of some weeks or months a diffuse pulpy swelling develops over a bone and this swelling is tender to the touch. The skiagram at this time will show normal underlying osseous tissue. When caseation occurs the swelling becomes more circumscribed but it is more irregular in shape than an ordinary node. If a tubercular abscess results, the overlying tissues become indurated, reddened and finally break down when the tubercular matter is discharged through the sinus. If mixed infection occur, the symptoms are correspondingly aggravated.

**Treatment.** Hygienic, dietetic and supporting until either caseation or suppuration occurs or until a neighboring joint is threatened. If any of these three conditions eventuate a free incision should be carried down to the bone, all granulation tissue and softened bone freely curetted away, the cavity disinfected and irrigated, dusted with sterile iodoform crystals, packed with sterile iodoform gauze, and an aseptic dressing applied. If a rib be involved complete excision of the diseased portion is advisable.

**State at what period of life neuralgia of the fifth nerve usually occurs.**

Neuralgia of the fifth nerve is more common during middle life. It may be present in advanced life and is very rare in children.

**Mention the diseases that may be mistaken for abscess.**

Aneurism, a rapidly growing sarcoma, a cyst, a fatty tumor.

**Give the treatment of actinomycotic periostitis.**

Complete removal of the affected tissue. If inoperable, large doses of potassium iodide.

**Give the treatment of shock and collapse resulting from severe hemorrhage.**

Intravenous infusion of normal saline solution in addition to the ordinary treatment of shock as detailed on page 106.

**Give the treatment necessary for rapidly and completely healing the cavity of an abscess.**

Early and free incision. The finger should be introduced and any existing loculi destroyed after which the cavity is to be gently curetted, irrigated, packed with iodoform gauze, and made to heal from the bottom. The general principles of the local and constitutional treatment of inflammation (described elsewhere) should also be carefully applied.

**Mention some of the diseases that may be mistaken for empyema of the maxillary sinus.**

Ozaena, hydrops, antral sarcomata.

**Give the symptoms and the treatment of pyemia.**

Symptoms. Pyemia is ushered in with a severe rigor which is followed by fever and profuse diaphoresis. The rigors are repeated at irregular intervals and although the temperature falls between the rigors it never quite reaches the normal. The skin is hot and soon takes on an icteroid tinge sometimes exhibiting erythematous or petechial patches. The breath has a sweet mawkish odor which has been compared to that of apples or to that of new-mown hay. The tongue may be red but is more frequently dry and brown. The pulse soon becomes soft and weak, constipation is present, and nocturnal delirium may be observed although the patient's mind usually remains clear to the end. With the deposition of each fresh metastatic abscess there is a sharp rise of temperature accompanied by a chill and followed by free sweating. The joints may fill up with pus over night and this without causing the patient any local pain whatever. The joints frequently involved are the knee-joint, the sterno-clavicular articulation, and the sacro-iliac synchondrosis. The original wound, though it may have been secreting freely, becomes dry and glazed.

Treatment. The focus of infection should be removed as freely as possible and all metastatic abscess should be efficiently drained wherever practicable. The constitutional



treatment should be supporting, consisting of a liquid nutritious diet, hypodermatic injections of strychnine, and alcohol (in the form of whisky) administered with a free hand. Intravenous infusion of normal saline solution may be of some value.

### **Give the symptoms and treatment of rickets.**

Symptoms. The child may be flabby or emaciated. Vomiting and diarrhea are usually present, the evacuations being green, slimy and most offensive. The spleen is enlarged and the abdomen is protuberant. Particularly characteristic is the sweating about the head.

The osseous changes are ushered in by increasing irritability and restlessness, the child crying out when picked up or even touched. The articular ends of the long bones become enlarged as do also the chondrocostal junctions ("rickety rosary"). The head is flattened anteroposteriorly so that it appears box-like, the fontanelles remain open much longer than usual, and dentition is delayed. Kyphosis, scoliosis or a combined curvature of the spine may be present. The sternum is pushed forward and the curvature of the ribs becomes exaggerated at their angles so that a "pigeon breast" is produced. The pelvis becomes either flattened (when patient is kept supine) or triradiate (when allowed to walk). The natural curves of the long bones become increased, particularly at those points giving attachment to powerful muscles. Growth is frequently checked by the presence of this disease.

Treatment. Correction of hygienic and dietetic errors. Properly modified cow's milk, beef juice, attention to the condition of the bowels, and an abundance of fresh air and sunshine. Deformities should be prevented by keeping the child off his feet; if slight they may be corrected by daily manipulation of the affected bones or by braces. Where deformity persists it should be overcome by osteotomy or even by resection of the affected portion.

**Describe the symptoms of actinomycotic periostitis.**

This disease usually affects the lower jaw, the ray fungi gaining entrance to the parts through an abrasion of the mucous membrane. There is a chronic "board-like" or "wooden" induration of the tissues which subsequently breaks down and discharges through sinuses. In the slimy discharge will be found characteristic yellow granules which are gritty to the touch from their contained lime-salts and which may be recognized under the microscope as the actinomyces. As a rule there is little pain and but slight constitutional disturbance.

**Give the symptoms and treatment of tubercular abscesses.**

**Symptoms.** The local symptoms will vary with the particular tissue affected. In bone, for example, severe aching or boring pain may be experienced in a fixed location at one extremity of the shaft. This pain may be absent in the day-time. It may be intermittent, disappearing altogether to make its reappearance after weeks or months, often without assignable cause. Tenderness may be elicited. A slight enlargement of the bone may be detected and late in the case a dusky red area appears over the tender area indicating the future formation of a sinus. Constitutional symptoms may be entirely absent until caseation occurs when there will be an evening rise of temperature. If mixed infection take place suppurative fever will result.

**Treatment.** Hygienic, dietetic, and supporting until caseation occurs when the tubercular material should be removed as thoroughly as possible, the cavity curetted until healthy tissue is reached, after which it should be irrigated and packed with iodoform gauze. If the abscess be in a gland or a joint, excision is the ideal method.



## PATHOLOGY.

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**What are spores? How may nutrient media be freed from spores at a temperature below 100 degrees C.?**

Spores are reproductive bodies of lower vegetable organisms (of bacteria, for example).

Nutrient media may be freed from spores at a temperature below 100° C. by the process of fractional sterilization. The nutrient media are exposed to a temperature of 80° C. for 15 minutes. This destroys the bacteria, and the media are then kept at the room temperature for 24 hours so that the spores may develop into bacteria. These bacteria are destroyed by an exposure to 80° C. for 15 minutes upon the second day. This process is repeated the third and sometimes the fourth day, at which time the media will be free from spores.

**Define pathology.**

Pathology is that branch of medical science which treats of modifications of function and changes in structure caused by disease.

**Define leukomains. State where they are found.**

By leukomains are meant any of the nitrogenous bases or alkaloids normally developed by the metabolic activity of living organisms, as distinguished from the alkaloidal substances developed in dead bodies and called ptomains.

They have been found in almost all of the tissues of the body.

**Mention the different kinds of tumors of the gums.**

Simple epulis (fibroma), malignant epulis (myeloid sarcoma), round-celled sarcoma, spindle-celled sarcoma, and epithelioma.

**State the difference between parasites and saprophytes.**

A parasite is an animal or vegetable organism living upon or within another living organism.

A saprophyte is a vegetable organism living upon dead organic matter.

**How may inflammation terminate?**

Inflammation may terminate by resolution, retrogression (the formation of cicatricial tissue), suppuration, ulceration, or gangrene.

**Name the various tumors of the tongue.**

Papilloma, fibroma, lipoma, myxoma, angioma, lymphangioma, and epithelioma. Lymphadenoma and lymphosarcoma may occur at the root of the tongue. Chondroma has also been found in the submucous tissue of the tongue.

**What is the most common syphilitic lesion upon the tongue?**

Mucous patch.

**What is inflammation?**

Inflammation is the succession of changes which occur in a living tissue when it is injured, providing the injury is not of such a degree as to at once destroy its structure and vitality (Burdon Sanderson). It is "the response of living tissue to injury."

**Define sepsis, asepsis.**

Sepsis is a condition of poisoning produced by the absorption of putrefactive substances.

Asepsis is the absence of pathogenic micro-organisms.

**Give the differential diagnosis between sarcoma and carcinoma.**

A sarcoma arises from connective tissue, may occur at any age, may be encapsulated, gives metastasis through the blood-vessels, and the overlying integument frequently contains dilated veins.



A carcinoma arises from epithelial tissue, usually occurs after middle life, is never encapsulated, and gives metastasis through the lymphatic vessels.

**What is the difference between a ptomain and a toxin?**

A ptomain is a basic compound resembling the alkaloids, formed during the decomposition of animal or vegetable tissues.

A toxin is any poisonous substance, either albuminous or basic, produced by the action of bacteria upon organic matter.

A toxin is a poisonous ptomain.

**Give the pathology of sarcoma of the superior maxilla.**

Sarcoma originates from the anterior wall or from the cavity of the antrum or from the sphenomaxillary fossa behind the bone. The maxilla may be secondarily involved by sarcomatous naso-pharyngeal polypi which extend from the nose. These growths frequently contain considerable ossific deposits, and this is occasionally so extensive that the antral cavity is obliterated and the bone converted into a solid mass.

**Name tumors of the buccal parietes.**

Papilloma, naevus, cavernous angioma, and epithelioma.

**Mention four forms of abscesses.**

Acute or hot, chronic or cold, residual, and metastatic.

**What is an embolus?**

An embolus is a particle of fibrin or other material which is swept into the blood current and which is capable of forming an obstruction at its place of lodgment.

**What is an aneurism? Mention three varieties.**

An aneurism may be defined as a sac containing blood and communicating with the interior of an artery.

Fusiform, saccular, and dissecting.

**Mention five forms of inflammation.**

Fibrinous, diphtheritic, suppurative, hemorrhagic, and gangrenous.

**What are the active agents in decomposition?**

The active agents in decomposition are the saprophytic bacteria.

**Define pasteurization. How does pasteurization differ from disinfection and sterilization?**

Pasteurization is a process of checking fermentation in organic fluids by heating them to 60° or 70° C.

It differs from disinfection, since in disinfection the bacteria are destroyed by the use of chemical agents.

It differs from sterilization, since in sterilization, the temperature is carried higher and the bacteria are destroyed, whereas in pasteurization the temperature is simply raised to a point where few fungi can flourish.

**Give the lesions in syphilitic affections of the buccal mucous membrane.**

The initial lesion (chancre) may rarely occur in this situation. In secondary syphilis there is often a chronic inflammation of the buccal mucous membrane and mucous patches (mucous tubercles, condylomata) are not infrequently present.

**State what micro-organisms produce pus.**

*Staphylococcus pyogenes aureus*, *staphylococcus pyogenes albus* (*staphylococcus epidermidis albus*), *staphylococcus pyogenes citreus*, *streptococcus*, *bacillus coli communis*, *bacillus typhosus*, *pneumococcus*, and *gonococcus*.

**Describe the structure of a bacterial cell.**

The cell is principally composed of an albuminous substance known as mycoprotein. There is a large nucleus situated in the centre of the cell constituting its great bulk. This is surrounded by a very delicate cell-wall. In some bacteria, cilia or flagella may be observed extending away from the cell-wall. In other bacteria, the cell-wall seems to undergo a gelatinous transformation so that the bacteria seem to be surrounded by a halo or capsule (*pneumococcus*).

**State the difference between benign and malignant tumors.**

Benign tumors are usually encapsulated, do not give metastasis, do not recur upon removal, produce no cachexia, grow slowly, do not infiltrate, are not painful (except by pressure), and do not cause death (except by location).

Malignant tumors are never effectively encapsulated, give metastasis, recur upon removal, produce cachexia, usually grow rapidly, infiltrate, are painful, and cause death.

**What is the usual source from which pathogenic bacteria are derived? State the conditions under which micro-organisms get into the air.**

Pathogenic bacteria are practically always derived indirectly from the bodies of diseased human beings or lower animals. They may be inhaled with the air (tuberculosis), ingested with the liquids or food (cholera and typhoid), or gain access through wounds.

The micro-organisms get into the air from the soil. The excreta of diseased individuals becomes dried, ground up into dust, and these dust particles loaded with bacteria are disseminated by the winds. Micro-organisms rarely pass from fluids into the air.

**Describe a method of making gelatine plates.**

Three tubes of sterile gelatine are to be liquefied by heat. Tube No. 1 is inoculated with the infectious material by means of a platinum wire. Tube No. 2 is now inoculated from tube No. 1, and tube No. 3 is inoculated from tube No. 2. The contents of these tubes are now poured into three previously sterilized Petri dishes. In all of these manipulations, precautions must be taken to avoid accidental contamination of the culture medium.

**Differentiate thrombosis and embolism.**

By thrombosis is meant a clotting of the blood within the heart or blood-vessels. It is due to a slowing of the current, or to an altered condition of the blood or blood-vessel walls.

By embolism is meant the obstruction of a blood-vessel (particularly an artery) by a fragment of matter brought from another point. This fragment of matter or embolus may be a detached piece of a thrombus.

**How does suppuration spread?**

Suppuration spreads by the peptonization of the inflammatory exudate by the pyogenic cocci. It spreads in the direction of least resistance.

**State the usual method of cultivating bacteria.**

The usual method of cultivating bacteria is to inoculate any of the ordinary culture media with the bacteria in question, and then to keep the media under conditions favorable for the growth of the micro-organisms. Bouillon, agar agar, potato, etc., may be kept in the brood-oven; gelatine is kept at room-temperature.

**Define oral pathology.**

Oral pathology is the study of the modifications of function and changes in structure as they occur in the mouth and adjacent parts.

**Mention the principal diseases of the maxillary bones.**

Osteomyelitis and its sequelae, alveolar abscesses, periostitis, tuberculosis, syphilis (gummata), osteoma, chondroma, fibroma, myxoma, carcinoma, sarcoma, and empyema (upper jaw).

**Describe the histologic structure of carcinoma.**

The structure will vary according to the region involved. The tumor is made up of epithelial cells and a stroma of connective tissue. In epithelioma of the skin, the cells are of a squamous type; in carcinoma of mucous membranes, they are cylindrical and there is a tendency to the formation of cuboidal epithelium. The cells show secondary changes (dropsical infiltration, mucoid degeneration, fatty degeneration, etc.). Karyokinetic figures may be abundant and are frequently atypical.

The epithelial cells are usually grouped into acini or into alveoli containing several layers of epithelial cells. At the periphery of the acini, the cells may break through the basement membrane.

The connective tissue stroma is of varying density, but is always of a fibrous character. It is arranged so as to form hollow spaces which contain the epithelial cells.

**What are the active causes of carcinoma of the buccal cavity?**

Any irritation, such as smoking, a sharp tooth, the stem of a pipe, or a badly-fitting plate. Leukoplakia, chronic glossitis, and probably caustics.

**What is the cause of pain in inflammation?**

The pain in inflammation is caused by the exudate stretching and pressing upon the filaments of the sensory nerves. Another factor in the production of inflammatory pain is the chemical irritation of the sensory filaments by the toxins produced by the bacteria.

**What is the difference between catarrhal and suppurative inflammation?**

In catarrhal inflammation there is usually considerable liquid exudation, retention cysts may form in the mucous glands, and even localized erosions may appear. There is a hypersecretion of mucus and a desquamation of epithelium.

In suppurative inflammation, the exudate contains a large amount of leukocytes, which are killed and transformed into pus cells.

**What is periostitis?**

Periostitis is an inflammation of the periosteum.

**What is provisional callus, and where is it found?**

Provisional callus is the temporary splinting-material which nature throws out about the ends of fractured bones.

It is found outside of the ends of the fragments (ring



callus) and within the medullary cavities of the fragments (pin callus).

**Give some of the pathologic and anatomic characteristics of a benign tumor.**

Benign tumors usually resemble the tissue from which they grow, tend to unlimited growth, are encapsulated, do not adhere to surrounding structures, do not infiltrate, do not give rise to metastasis, do not recur when thoroughly removed, have a nutrition which is independent of the general nutrition of the body, and do not cause death (except mechanically).

**What is meant by intermediate or definitive callus? Where is it found?**

Definitive callus is the callus which ultimately unites the fragments of fractured bone. It is the metamorphosis of this tissue that results in bony union.

It is found between the ends of fractured bones.

**What effect has increased nutrition on tissues?**

It may result in fatty infiltration, in more rapid growth, or in hypertrophy.

**What effect has imperfect nutrition on tissues?**

It causes them to degenerate and atrophy.

**Differentiate between syphilitic and congenital cleft palate.**

Syphilitic perforation is practically always due to a broken-down gumma. There will be a history of preceding syphilis and concomitant lesions in some portion of the body. The perforation will have been accompanied by marked inflammatory symptoms, well remembered by the individual.

Congenital cleft palate is present at birth and is due to a failure of union of the two palatal processes.

**Differentiate fibrous from sarcomatous epulis.**

Fibrous epulis grows slowly, is hard, painless, pale-red, and rarely attains a larger size than that of a walnut.

Sarcomatous epulis grows rapidly, is softer, painful, livid in color, ulcerates sooner, and may attain the size of an apple.

**Mention the tumors of the buccal cavity.**

Fibroma, lipoma, myxoma, chondroma, osteoma, lymphadenoma, lymphosarcoma, spindle-celled sarcoma, myeloid sarcoma, papilloma, and carcinoma.

**Define abscess. State of what the walls of an abscess consist and describe its growth.**

An abscess is a circumscribed collection of pus in a cavity of abnormal formation.

The walls consist of granulation tissue.

The vessels of the affected area become dilated and the various elements of the blood pass through the walls. As the pyogenic organisms develop, retardation and stasis followed by thrombosis occur successively, whilst the exudation of cells becomes so great that the original tissue of the part disappears, after passing through a stage of coagulation necrosis. This removal of the infiltrated tissues is largely caused by their liquefaction, owing to the peptonizing power of the bacteria.

**State how a dead pulp may cause empyema of the maxillary sinus.**

The dead pulp may become infected and give rise to an alveolo-dental abscess, which ruptures into the maxillary sinus or causes a purulent inflammation of its lining by contiguity of structure.

**Define atrophy. Give the pathologic anatomy of atrophy.**

Atrophy is a reduction in bulk of one or more of the component parts of an organ, and the functional activity is reduced.

The organ is reduced in size; its consistency may be increased; the outline of the organ may become irregular, and there is an increase of pigment. The microscope shows a reduction in the size of the individual cells.

**Give an effective method of sterilizing hypodermic syringes.**

The modern hypodermic syringe consists entirely of metal, and can be effectively sterilized by boiling it for five minutes in a 1% solution of sodium carbonate.

If boiling water is drawn up into the old glass and metal syringe and then ejected, and this is repeated six or eight times, the syringe will be practically sterile. This method is more reliable than solutions of carbolic acid or bichloride (Eiselsberg).

**State in what manner micro-organisms enter the body.**

Through the respiratory tract, through the gastro-intestinal tract, through solutions of continuity of the skin and mucous membranes, and through the placenta.

**State the difference between asepsis and antisepsis.**

In asepsis, an effort is made to prevent the entrance of germs into a wound. The greatest reliance is placed upon mechanical purification and upon sterilization by heat.

In antisepsis, an effort is made to destroy the germs in a wound as well as to prevent the entrance of more bacteria. The greatest reliance is placed upon chemical agents.

**How and under what conditions do bacteria multiply?**

Bacteria multiply by fission (direct division), and by sporulation (development of spores).

The following conditions are requisite for the multiplication of bacteria:

1. Presence of oxygen (aerobic bacteria). Absence of oxygen (anaerobic).
2. A certain amount of organic matter.
3. A certain amount of moisture.
4. A neutral or feebly alkaline reaction, for the majority of bacteria.
5. A temperature above 16° C. and below 40° C.
6. The majority of bacteria multiply most rapidly when the medium in which they grow is at rest.

**Define antitoxin, virulent germ, non-virulent germ.**

An antitoxin is a counter-poison elaborated by the body to counteract the toxins of bacteria.

A virulent germ is one having marked pathogenetic properties.

A non-virulent germ is one the pathogenetic properties of which are not marked.

**Differentiate hypertrophy and tumor.**

Hypertrophy is an increase in bulk of a tissue or organ occurring independently of the general growth of the body. In a true hypertrophy the function is increased.

A tumor is an atypical new formation tending to unlimited growth, having no function, differing from the tissue in which it is found in gross and minute structure, the nutrition of which is independent of the nutrition of the body in general, and which is not dependent upon or coincident with inflammation.

**What are pathogenic bacteria? State how pathogenic bacteria incite disease processes.**

Pathogenic bacteria are those which produce disease.

After gaining an entrance to the tissues, they may incite disease processes in one of the following ways:

They may grow so rapidly that they completely block up the blood and lymphatic channels.

They may cause a local inflammation, due partly to the presence of the foreign organisms and partly to their toxic metabolic products.

More often, however, they produce powerful metabolic poisons, which destroy the tissues immediately acted upon, or circulate through the organisms and overflow the normal physiologic equilibrium.

**Define carcinoma. Give with reference to carcinoma (a) congenital theory, (b) traumatic theory, (c) clinical appearance.**

A carcinoma is a malignant epithelial tumor, composed of

a connective tissue stroma, surrounding groups or nests of epithelial cells.

(a) Congenital theory.—The carcinoma is supposed to grow from embryonal rests or “resting spores.”

(b) Traumatic theory.—The carcinoma develops as the result of a single traumatism or of repeated irritations.

(c) Clinical appearance.—The tumor occurs in an individual past middle life, is fixed to the surrounding tissues, and may be ulcerated. The neighboring lymphatic glands are enlarged, the tumor is the seat of lancinating pain, and cachexia is present.

### **Distinguish between pathologic regeneration and physiologic regeneration.**

Physiologic regeneration is that which occurs in the normal life of the organism, and by which the cellular wear and tear is counterbalanced. The tissue destroyed is replaced by similar tissues.

Pathologic regeneration is the more massive and open atypical reconstruction that follows disease or injuries. The tissue destroyed is almost always replaced by connective tissue.

### **What is disinfection? How may the strength of a disinfectant be determined?**

Disinfection is the destruction of micro-organisms, particularly by the action of chemicals.

The strength of a disinfectant may be determined by bringing definite quantities of the infected material in contact with definite quantities of a series of solutions of graded strengths, and subsequently making cultures from the infected material, which has been thus exposed, to determine whether the organisms have been completely destroyed.

### **How do wounds heal?**

Wounds heal:

1. By immediate union.
2. By first intention.



3. By organization of a blood clot.
4. Under a scab.
5. By second intention (granulation).
6. By third intention (adhesion of granulating surfaces).

By the first four methods the wound heals without the formation of pus; in the last two methods suppuration is present.

**Mention the different varieties of tumors of the superior maxilla.**

Myxoma, fibroma, chondroma, osteoma, odontoma, sarcoma, and carcinoma.

**Define pus. Give the specific gravity and varieties of pus.**

Pus is a thick, opaque, creamy fluid; it is smooth and slightly glutinous to the touch, has a faint odor and a slightly sweetish taste. It is neutral or feebly alkaline in reaction.

The specific gravity of pus varies between 1021 and 1042.

The varieties of pus are: The so-called healthy pus, ichorous pus, sanious pus, fetid pus, curdy pus, muco-pus, and sero-pus.

**Define suppuration.**

By suppuration is meant the formation of pus.

**Define diathesis.**

A state or condition of the body whereby it is especially liable to certain diseases. It may be acquired or hereditary.

**Define cachexia.**

A depraved condition of general nutrition due to some serious disease, such as syphilis, tuberculosis, carcinoma.

**Into what classes are bacteria divided?**

According to their morphology, bacteria are divided into: (1) Cocci, (2) Bacilli, (3) Spirilla. These are relatively monomorphous. Three other varieties might be mentioned: (4) Spirulina, (5) Leptothrix, (6) Cladothrix. These are relatively pleomorphous.

**Define plethora, anemia, hyperemia.**

By plethora is meant an increase of the total amount of the blood in the body.

By anemia is meant a deficiency of the blood as a whole, a deficiency of the red corpuscles, or of the hemoglobin.

By hyperemia is meant an increased amount of blood in the more or less dilated vessels of a part.

**Describe (a) local hyperemia; (b) passive hyperemia.**

All hyperemias are local. By hyperemia is meant an increased amount of blood in the more or less dilated vessels of a part.

By a passive hyperemia is meant an increased amount of blood in the more or less dilated veins and capillaries of a part with diminished velocity of the blood stream. The part is bluish and swollen. Nutrition, function, and temperature are all decreased.

**Define hemorrhage.**

By hemorrhage is meant the escape of the several constituents of the blood from the blood-vessels.

**What is meant by chromogenic and pyogenic bacteria?**

Chromogenic bacteria are those which produce colored colonies or impart color to the medium in which they grow.

Pyogenic bacteria are those capable of producing pus.

**What is a culture medium? What is a pure culture?**

A culture medium is a mixture in which it is possible to cultivate bacteria.

A pure culture is a culture of a single species of bacteria.

**What are toxalbumins?**

Toxalbumins are toxic substances produced by either animal or vegetable cells. They are albuminous in character, giving the ordinary reactions for albumin.

**Distinguish between cocci, bacilli, and spirilla.**

Cocci are bacteria having a spherical shape.

Bacilli are elongated or rod-shaped bacteria.

Spirilla are bacteria having a spiral shape and bear some resemblance to a cork-screw.

**State why the mouth is a favorable place for the development of bacteria.**

Because heat, moisture, oxygen, and decomposing organic matter are constantly present.

**Name the classification of cocci from the number and order of arrangement of the cells.**

Diplococci, tetragenococci, merismopedia, sarcina, streptococci, streptodiplococci, and staphylococci.

**Differentiate between aerobic, anaerobic, and facultative bacteria.**

Aerobic bacteria are those which grow in the presence of oxygen.

Anaerobic bacteria are those which do not grow in the presence of oxygen.

Facultative bacteria are those which grow either with or without oxygen.

**Define general pathology; special pathology.**

General pathology is the study of morbid processes in general without reference to the individual organs.

Special pathology is the study of morbid processes in the individual organs.

**State what is meant by (a) the predisposing cause of disease; (b) the exciting cause of disease.**

A predisposing cause of disease is one which places the individual in a condition favoring the action of the exciting cause; it prepares the system or part by rendering it weaker and less resistant.

The exciting cause of disease is the immediate or specific cause of the disease.

**Classify the diseases due to bacteria.**

The following is the classification of McFarland:

**A. The Phlogistic Diseases.**

1. The Acute Inflammatory Diseases, suppuration.

2. The Chronic Inflammatory Diseases. (a) Tuberculosis; (b) Leprosy; (c) Glanders; (d) Syphilis; (e) Actinomycosis; (f) Mycetoma or Madura-foot; (g) Farcin du Boeuf; (h) Rhinoscleroma.

**B. The Toxic Diseases.** (a) Diphtheria; (b) Tetanus; (c) Hydrophobia or rabies; (d) Symptomatic anthrax; (e) Typhoid fever; (f) Cholera; (g) Pneumonia.

**C. The Septic Diseases.** (a) Relapsing fever; (b) Influenza; (c) Malignant Edema; (d) Measles; (e) Bubonic Plague; (f) Tetragnus; (g) Chicken Cholera; (h) Mouse Septicemia; (i) Anthrax; (j) Typhus Murium.

**Mention the pathologic changes in gangrenous stomatitis.**

The pathologic changes are those of a rapid necrosis of all the tissues; the micro-organisms of suppuration and putrefaction are present. Putrefactive changes are always in evidence; intense septic infection and intoxication are almost always observed.

**From what do cysts of the alveolar process arise?**

Dental cysts are inflammatory in their origin and are formed in connection with the fang of a tooth.

Dentigerous cysts arise from imperfectly developed teeth which have been retained in the jaw.

Multilocular cysts may be either fibrocystic tumors or cysts developed in adenomatous or sarcomatous tissues.

**✓ Describe the process of repair of fractures.**

In a simple fracture the ends of a broken bone and the contiguous lacerated tissues are immediately surrounded by a clot of blood. As a result of simple traumatic inflammation, exudation occurs and the clot is invaded by leucocytes.

which absorb it and the damaged tissues. There now occurs an infiltration of large plasma cells derived from a multiplication of the pre-existing connective-tissue cells of the part. Vessels grow into this tissue from the surrounding parts so that it becomes organized and converted into granulation tissue, which is known as callus. The plasma cells destroy the emigrated leucocytes and are converted into fibrous tissue, which contracts and obliterates the vessel. This scar tissue now undergoes calcification and ossification. The intercellular substance increases in quantity, the cells become angular, resembling osteoblasts, lime salts are deposited around them, and true bone is formed in the same manner as in the usual process of ossification.

#### **Mention and explain the causes of inflammation.**

The predisposing causes of inflammation are those which depress the vital powers and render the individual more susceptible to the action of the exciting causes. The predisposing causes of inflammation are hereditary tendencies, bad habits, faulty hygiene, and dietetic errors, diminished innervation, organic visceral disease, and certain states of the blood (such as anemia).

The exciting causes of inflammation are the immediate or specific causes of the inflammation. These are: (1) Direct injury (mechanical, chemical physical); (2) the chemical products of putrefaction; (3) infective micro-organisms.

#### **What is meant by regeneration of tissue and how is it brought about?**

By regeneration is meant the formation of new cells or tissues to take the place of those destroyed.

Physiologic regeneration is brought about by a process of gradual cell-multiplication without marked changes of any sort.

Pathologic regeneration is brought about by the process of inflammation.



**Define (a) etiology, (b) morbid anatomy, (c) diagnosis, (d) prognosis.**

Etiology is that branch of pathology which treats of the causation of disease.

Morbid anatomy is that branch of pathology which treats of the changes of structure and form that take place in diseased conditions.

Diagnosis is the determination of the nature of a disease by a study of its symptoms.

Prognosis is a judgment in advance concerning the duration, course, and termination of a disease.

**What pathologic conditions may be caused by an impacted third molar?**

Hypertrophy of the pericementum, pressure-resorption of adjacent roots, the formation of a capsule of new bone about the impacted tooth, infringement of the root-apex upon the inferior dental vessels and nerve, and necrosis of the bone.

**What is fermentation? What causes it?**

Fermentation is the decomposition of complex molecules under the influence of ferments.

Fermentation is caused by enzymes, yeasts, and bacteria.

**What precautions should be taken to prevent septic infection?**

The wound or operative area should be made as sterile as possible and no septic substance should be allowed to come in contact with it subsequently. Asepsis is secured by mechanical purification, sterilization by heat, chemical disinfection, or by some combination of the three methods.

**What is the cause of an apical alveolar abscess? Describe the process of its formation.**

The infection of the pericementum by pyogenic organisms.

The purulent apical pericementitis is almost always preceded by death and putrefaction of the pulp, but consider-

able purulent destruction of the pericementum may occur near the apex of the tooth and the pulp of the tooth remain alive for a short time. In the latter case the path of infection is unknown, but the pyogenic organisms may be carried here by the blood from a distant focus of suppuration.

An abundant exudate is poured out into the interstices of the pericementum, the leucocytes die and form pus cells, the exudate is peptonized, and we have all the phenomena of abscess formation in other situations.

**What are salivary calculi? What conditions are produced by them?**

Salivary calculi are hard concretions composed of the calcium salts of the saliva which have been precipitated and combined with organic substances (usually mucin).

When situated in the salivary ducts, calculi may cause retention of saliva with inflammatory phenomena tending to abscess and subsequent salivary fistula.

When situated upon the teeth, they may cause gingivitis, absorption of the gum, destruction of the alveolus, or an ulcer of the tongue.

**What is the difference between a tumor and an inflammatory swelling?**

The reader is referred to the definitions of tumor and inflammation given in answer to some of the preceding questions. To differentiate these conditions further, it might be said that tumors are almost always unaccompanied by fever, unless there is some intercurrent infection, and that the tumor is not characterized by a local increase of temperature unless it is of very rapid growth. The benign tumors do not give rise to pain (unless by pressure), and the pain of a malignant tumor differs in character from that of inflammation. The swelling is usually more acute in the inflammation than in the tumor. Redness may be entirely absent in the neoplasm.

**Mention the varieties of pathogenic bacteria found in the air.**

The particular variety depends entirely upon the surroundings. The air of stables is apt to contain tetanus bacilli and possibly the bacillus of malignant edema. The air of a room in which a tubercular patient is kept may contain the tubercle bacillus, particularly if the sputum dries and is ground up and disseminated by the dust. The air of hospital wards may contain any of the bacteria producing infectious diseases or suppuration.

**Describe the characteristics of carcinomatous ulcer. Give the cause of putrefaction of carcinomatous ulcer.**

Epitheliomatous ulcers occur in individuals at or past middle life. They commence as a wart or fissure and steadily progress. The base of the ulcer bleeds easily; it is indurated, uneven, and covered with firm, pink granulations containing small, yellow specks. The edges are indurated and everted. The neighboring lymphatic glands enlarge after a time and become adherent to each other and to the overlying skin. Early in the disease the secretion is scanty and viscid and pain may be entirely absent.

If the epithelioma is deep-seated, it commences as a reddish tubercle, which breaks down into an irregular ulcer with a foul, bleeding, indurated base. Pain is often severe, and lymphatic involvement occurs earlier than in the more superficial variety first described, but it is not so precocious as in the other forms of carcinoma.

Carcinomatous ulcers also result from the breaking-down of deep-seated carcinomata. They vary with the structure of the tumor and may be fungating or excavated. They are always attended by pain, involvement of the neighboring lymphatic glands, foul discharge, and cachexia.

Putrefaction in a carcinomatous ulcer is due to the same causes as putrefaction elsewhere, *i. e.*, the presence of saprophytes and dead organic matter. The malignant neo-

plasm outgrows its circulation, a portion necessarily dies, and this dead organic matter is attacked by the saprophytes. The heat, oxygen, and moisture which are always present, aid in the process.

**Name two culture media.**

Gelatin and agar-agar.

**What is a sanguinary or serumal calculus?**

A sanguinary or serumal calculus is a hard, dark calculus which may be deposited anywhere between the neck of the tooth and the apex of the root. As indicated by the name, it is derived from the blood instead of from the saliva.

**What are phleboliths?**

Literally, "vein-stones." The term is applied to concretions formed in the veins. They usually consist of dense, fibrous bodies, the result of calcification following a venous thrombus.

**What is exostosis?**

It is a circumscribed overgrowth of the cementum, extending beyond the line of the fang of the tooth and giving an irregular outline to its external surface.

**Give the etiology and clinical pathology of osteosarcoma.**

The etiology of sarcoma is as obscure as that of tumors in general. It occurs most frequently in young and middle-aged people particularly affecting the first and fourth decennial periods although it may be congenital. Trauma seems to be a more important factor in the development of sarcoma than in that of carcinoma.

Osteosarcomata may be endosteal (central) or periosteal (peripheral). The endosteal growths may be myeloid (giant-celled) round-celled, or spindle-celled. The periosteal sarcomata are either round or spindle-celled.

The myeloid endosteal sarcomata are relatively benign, rarely giving rise to metastasis, and show a marked predilec-

tion for the inner side of the knee (the internal femoral condyle, the internal tibial tuberosity) the upper end of the humerus, and the lower end of the radius.

The round or spindle-celled endosteal sarcomata are extremely malignant. Although the growth may not expand the bone to any great extent, it extends throughout the medullary cavity and gives early metastases to the viscera or to the lymphatic glands.

Either variety of endosteal growth may give "egg shell crackling" late in the

The periosteal sarcomata grow very rapidly but do not give rise to great pain unless the bone be eroded. They commence at one side of the bone and soon spread about its entire circumference. These tumors frequently exhibit marked pulsation and a network of dilated veins may be seen through the overlying integument. The small round-celled periosteal sarcomata are the most malignant of all tumors, destroying life in from six to twelve months.

**State the degree of temperature most favorable to the development of pathogenic bacteria.**

The temperature of the human body.

**Give the etiology of rickets.**

In general any error of hygiene or diet. Insufficient or improper food, particularly the too early administration of starches. Prolonged nursing by the mother if she be unhealthy. Overcrowding, uncleanness, and insufficient air and light.

**Give the predisposing and the exciting causes of neuralgia.**

Predisposing Causes. The hysterical temperament, anemia, depressing circumstances of all kinds such as mental anxiety and worry.

Exciting Causes. Toxic, malaria, influenza, lead, mercury. Reflex,—ovarian disease, worms. Central,—disease of the



brain or spinal cord. Peripheral,—pressure upon the nerve roots, lesions of the nerve-trunks whether they be due to trauma, inflammation, or new growths.

**Give the predisposing and the exciting causes of tetanus. State the period of incubation of tetanus.**

Predisposing causes. The presence of a wound. Tropical climates. Occupation (stable attendants, agricultural laborers). Race, (dark-skinned people,—Spanish, Italian, and negroes). Defeat in battle. Bad hygiene, particularly the overcrowding of sick or wounded people in a limited space especially if antiseptics be impossible.

Exciting cause. The introduction of the bacillus tetani.

The period of incubation is exceedingly variable. It is usually stated to be from five to fifteen days although it may develop within a few hours or fail to make its appearance until a month has elapsed.

**Give the etiology of tubercular periostitis.**

Tubercular periostitis is immediately due to the deposit of tubercle bacilli in the deeper layer of the periosteum. The predisposing causes are those of inflammation in general.

**Name the different types of necrosis.**

Peripheral, central, and total.

**Describe the formation of tubercular abscesses.**

The first effect of tubercle bacilli upon the tissues is to stimulate the fixed connective tissue of the part, causing a proliferation of round cells which from their abundance of protoplasm are known as epithelioid cells. There next occurs an infiltration with leucocytes from the surrounding blood-vessels. Giant cells have been said to result from the fusion of epithelioid cells but it seems more likely that they are due to the rapid multiplication of nuclei of these cells. The giant-cells are found in the center, then come the epithelioid cells, and finally abundant round-cells in the peripheral portion of the tubercle. The surrounding tissues usually shows

a tendency to encapsulate the tubercle by the ordinary inflammatory reaction similar to that produced by any irritant. In young tubercles of tubercular origin, the specific bacilli may be demonstrated in the epithelioid or subsequently in the giant-cells. In older tubercles the bacilli are rarely demonstrable although injection experiments show that spores must be present. As a result of the avascularity of the tubercle, together with the specific action of the living tubercle-bacillus, caseation takes place. True pus never results from the tubercle bacillus alone but is always due to mixed infection. The inflammatory reaction of the surrounding tissues results in the formation an abscess-wall which consists of an outer fibrocatricial layer and of an inner layer of yellowish-gray or pinkish granulation tissue containing miliary tubercles or even undergoing caseation.

## PATHOLOGY AND THERAPEUTICS.

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### **What changes occur in inflammation?**

Primarily.—A marked increase in the velocity of the blood-current and a dilatation of the vessels (arteries and capillaries), caused by a stimulation of the vaso-dilator, or a paralysis of the vaso-constrictor, nerves, followed by a decrease in the velocity of the blood and increased pressure with heightened temperature and redness. Leucocytes collect along the walls of the vessels and migrate through them by a process called diapedesis. Exudates pour into the intercellular spaces and the part becomes swollen, causing pain by pressure upon the nerve filaments. If resolution occurs, the inflammatory effusions will be taken up by the lymphatics and the part restored to health. If, on the other hand, supuration occurs, death of the part, or necrosis, may follow.

### **What is septicemia and what causes it?**

It is a condition in which septic matter gains access to the circulating fluids of the body, caused by the absorption of the toxins produced by bacteria.

### **How do you treat putrescent pulps?**

The contents of the pulp cavity and canals should be sterilized with a ten per cent. solution of formalin, after which the pulp should be removed with sterilized broaches, great care being exercised not to force any of the canal contents into the apical space. Canals should then be thoroughly cleansed with sodium dioxide, followed by an application of dilute sulphuric acid. Neutralize the acid with a bicarbonate of soda solution, dry with absolute alcohol, and fill canals with antiseptics on cotton, or fill permanently as indicated.

**What symptoms indicate diseases of the dental pulp?**

Paroxysms of pain upon application of thermal test, increased pain upon assuming a recumbent position, neuralgic pain along the course of the fifth nerve.

**Why is a pulp capped? When? How?**

To preserve its vitality. In young patients when the pulp has been exposed by accident in excavating. Make a concave disc of gold, platinum, tin or copper, large enough to completely cover the exposure; fill the disc with a paste made from zinc oxide and one of the essential oils, place this over the exposure and seal over with zinc oxysulphate. Cover the whole with a temporary filling. If pulp continues vital and normal for three or six months, it is reasonably safe to insert a permanent filling.

**Which tissue of the tooth dies with the pulp, and which remains alive?**

The dentine dies with the pulp, and the cementum remains alive.

**What are parasitic bacteria, and how do they cause disease?**

Parasitic bacteria are those forms which subsist upon living animal tissue, producing toxins, which, when taken into the circulation, cause disease.

**How does mercuric chloride act as an antiseptic?**

Mercuric chloride acts as an antiseptic by destroying bacteria. The mercury in the compound when brought into contact with albuminous substances, combines with the albumin, thereby destroying its identity, as well as its vitality.

**What are some of the manifestations of pathological dentition?**

In deciduous pathological dentition, we may have gastrointestinal disturbances, marked stomatitis and, in severe cases, convulsions may occur. In permanent dentition, some of the

pathological conditions most frequently met with are impaction or eruption in malposition of third molars, impaction of lateral incisors, supernumerary teeth, fusion, irregularities as to the number of cusps, odontocles and dentigerous cysts.

**What are the principles of treatment in dental caries?**

The employment of an alkaline solution to neutralize acids present, removal of carious tissue, the destruction of micro-organisms by the use of germicides, and the hermetical sealing of the cavity by means of filling materials.

**What is the danger of chronic septic pericementitis, and what is the treatment?**

The danger is the opening of the pus cavity upon the face, or the infiltration of pus into the tissues surrounding the tooth, causing necrosis of the pericemental membrane and loss of tooth. The treatment consists of the mechanical removal by warm water of pus masses and the antiseptic treatment of the affected part, after which mild stimulation should be employed to hasten formation of granulation tissue.

**Name four agents used in acute diseases of the pulp and give the physiological action of each.**

Tr. Aconite administered in one-drop doses reduces the force of the circulation and acts as a sedative to the nervous system.

Carbolic acid, being antiseptic and sedative in its action, may be used in cases of hyperæmia of the pulp. A saturated solution of menthol in chloroform, if placed in a cavity of a tooth exhibiting symptoms of pulpitis (acute), has an anesthetic and antiseptic effect.

A paste of cocaine and glycerine may also be used in cases of pulpitis, which acts as an analgesic.

**What causes an alveolar abscess?**

Access of septic matter to the apical space, or direct bacterial invasion of that area during an attack of apical pericementitis.



**What is phagedenic pericementitis?**

A disease of the pericemental membrane producing necrosis of that organ. In this particular condition, calcareous deposits may be present, and gingivitis may not be marked.

**How do you diagnose exostosis?**

Exostosis is accompanied by the presence of vaguely reflected pains, it being usually impossible to locate the seat of the trouble; the X-ray, however, demonstrates the condition very efficiently.

**What causes induce periodontitis?**

Traumatism and septic infection.

**What dangers are to be apprehended from abscess upon the temporary teeth?**

Pus gaining access to the follicle of the permanent successor, interfering with its development. Non-resorption of the deciduous root causing mal-eruption of permanent tooth. Possible necessity for premature extraction of the temporary tooth, resulting in impaction or mal-eruption of permanent tooth.

**What results are likely to follow abrasion of the teeth?**

Heightened sensitivity of the dentine, and deposits of secondary dentine in the pulp cavity.

**What causes superinduce the devitalization of non-carious teeth?**

Traumatism, causing severe hyperæmia and death of the pulp by strangulation. This includes too rapid wedging, as well as too rapid movement in regulating cases.

**How would you conduct a thermal test to locate an inflamed pulp?**

By isolating each tooth with rubber dam and projecting against it, alternately, jets of cold and hot water, until the offending member has been located by an exaggerated response to the test.

**Give some causes of necrosis.**

Thrombus in a terminal artery; or, ligation of a vessel cutting off the supply of nutrition to the part.

**Which of the permanent teeth are most liable to pathological eruption, and why?**

The upper and lower third molars. The former frequently erupt with their occlusal faces directed toward the cheek owing to an insufficient space between the second molars and the pterygoid processes for their accommodation normally within the arch. The lower third molars are more frequently retarded in their eruption, also due to lack of space.

**Describe epulis within tooth cavity. Describe fungoid pulp.**

Epulis within a tooth cavity is a pedunculated fibrous growth gaining access to the cavity usually through an opening at the bifurcation of the roots of molar teeth. This opening is caused by caries. The condition resembles very closely fungoid pulp, a hypertrophic condition of the pulp which is fibrous in character and highly vascular.

**In what abnormal condition will resorption of the temporary teeth cease?**

In temporary teeth containing putrescent pulps, or a pericemental membrane in a suppurating condition, resorption may not occur.

**Describe and give the supposed cause for Hutchinson's teeth.**

Hutchinson's teeth present a notched appearance upon the cutting edges, the longitudinal axis of these edges being shortened. The supposed cause is congenital syphilis.

**How is pulp irritation from loss of tooth substance distinguished from sensitive dentine?**

If exaggerated pain is experienced from contact with instruments upon the abraded surface, the condition is that of

hypersensitive dentine. If this contact causes but a mild response and the thermal test produces marked paroxysms of pain, the condition may be diagnosed as irritation of the pulp.

**What results may follow the premature extraction of the temporary molars?**

The first permanent molar may tip forward and occupy the space which the second bicuspid should take upon eruption, thereby causing either mal-eruption or impaction of the bicuspid tooth.

**How would you differentiate between pericementitis and alveolar abscess?**

In pericementitis, the pericemental membrane becomes thickened, the tooth elongated and extremely sensitive to percussion. A reddening of the gum tissue is noted over the affected tooth. In alveolar abscess we have an exaggerated likeness to these symptoms together with swelling over the affected tooth, intense pain with a subsequent discharge of pus.

**Name some of the pathological conditions of the dental pulp.**

Passive and active hyperæmia, pulpitis, pulp nodules, dry and moist gangrene, and pulp hypertrophy.

**Give the cause of dental exostosis and describe the symptoms.**

The cause of dental exostosis may be extraction of the occluding tooth: the pericementum not being met by the accustomed resistance, proliferates cementum upon the apex of the root. Or, traumatic injury, causing continued mild irritation of the pericementum, may give rise to a like condition. The symptoms are vague pains about the affected tooth, sometimes assuming a reflected neuralgic type.

**How would you diagnose and locate an inflamed pulp where no cavity exists?**

By the thermal test.

**What are bacteria?**

Bacteria are minute organisms representing the lowest order of plant life.

**Give the symptoms of septicemia.**

The general symptoms of septicemia are fever and chills, diarrhoea, rapid and weak pulse and clammy condition of the skin. If the infection has been from a wound, the discharge coming from it will be putrid.

**What conditions are necessary for the growth and development of bacteria?**

Proper food-supply, removal of waste products, moisture, proper temperature and the presence of free oxygen. This last-named condition, however, is not necessary for the existence of the anaerobic bacteria.

**Give Miller's theory of dental caries.**

The presence of sugar in the mouth causes fermentation and the production of lactic acid which dissolves out the lime constituents of the teeth. Micro-organisms gain access to the dentinal tubuli and proliferate; they follow in the wake of the decalcifying process and subsist upon the organic tooth substance, producing acids.

**By and under what conditions is pus produced?**

Pus is produced by the invasion of the staphylococcus pyogenes aureus, citreus or albus, or by streptococcus pyogenes, the gonococcus, the bacillus pneumonae or other pyogenic organisms into an area susceptible to inflammatory changes, or already inflamed. The white blood corpuscles together with other wandering cells of the body, are devitalized by the bacteria and become pus corpuscles.

**What are leucocytes and what are their functions?**

Leucocytes are the white blood corpuscles. They exercise phagocytic activity, devouring and carrying away invading bacteria and other irritating organic substances which gain access to the tissues.

**Name some of the pathogenic fungi found in the mouth.**

*Micrococcus* of sputum septicemia.

*Bacillus salivarius septicus*.

*Micrococcus gingivae pyogenes*.

*Saccharomyces albicans*.

*Pneumo-bacillus*.

**What is meant by lactic fermentation and why is it of extreme interest to dentists?**

Lactic fermentation is that process or change which occurs in solutions of the fermentable carbohydrates, producing lactic acid. This product is of interest to dentists, as it is the prime factor in the production of dental caries.

**What effects may be produced in the mouth from the administration of large doses of calomel? Describe the condition.**

Large doses of calomel produce a condition known as mercurial stomatitis. The gums around the necks of the teeth become inflamed and swollen, ulceration of the mucous membrane occurs, the teeth become loosened, and there is a marked increase in the flow of saliva. The breath is fetid, and there is an unpleasant metallic taste in the mouth. The severity of these symptoms depends upon the susceptibility of the patient, as, in some cases, loss of the teeth occurs, and even necrosis of the maxillary bones.

**Differentiate between hyperaemia, inflammation and suppuration.**

Hyperaemia is an excess of blood in a part. Inflammation is the succession of changes (hyperaemia being one of these changes) which occur in a tissue during its effort to rid itself of an irritant, provided the irritant is not of sufficient strength to cause immediate death of the part. If, in the last stages of inflammation, resolution does not occur, and pyogenic organisms invade the inflamed area, suppuration, or the formation of pus, will occur.



**What is the source of nourishment of bacteria? How do they obtain oxygen?**

Bacteria contain no chlorophyl, and, therefore, have not the power to decompose water and carbon dioxide to effect the synthesis of starch. Hence, they are compelled to derive their nourishment from organic compounds. According to their method of obtaining oxygen, bacteria are divided into three classes; aerobic, those depending upon the presence of free oxygen, anaerobic, those not requiring free oxygen, as they possess the power to appropriate the oxygen from unstable organic compounds; and facultative, or those which flourish in either condition.

**What is salivary calculus, where is it found, and what effect has it?**

Salivary calculus is a deposition of the salts of lime (carbonate and phosphate), held in solution in the saliva, upon the surfaces of the teeth, usually near the gum margin, in proximal spaces and deep sulci. Carbon dioxide plays an active part in the precipitation of the calculus. Large deposits are frequently found near Steno's duct, the opening of the parotid gland, and on the lingual and labial surfaces of the lower interior teeth. Deposits of tartar have the effect of producing recession of the gum, causing sufficient irritation at times to produce inflammation and even suppuration. If allowed to continue, the deposits may be responsible for affections of the pericemental membrane and alveolar process, and also tooth loss.

**What is the difference between an antiseptic and a germicide, and give examples?**

Antiseptics prevent the action of pathogenic organisms and their products on the living body, but do not necessarily kill the micro-organisms. Germicides destroy the vitality of the germs of disease. Germicides are antiseptics, though antiseptics are not necessarily germicides. Iodoform is an antiseptic; mercuric chloride is a germicide.

**What is pyrozone? How does it act, and for what is it used?**

Pyrozone is a solution of hydrogen dioxide in water or ether. A 3% aqueous solution acts as an antiseptic and disinfectant; these properties are due to the setting free of oxygen when the solution is brought in contact with organic matter. In this strength, it is valuable in cases of ulcerative stomatitis, and also in softening deposits of calculus. For cleansing pus pockets, it is an effective agent. A 25% ethereal solution is used as a bleaching agent, caustic and styptic.

**How are the diseases of the pericementum diagnosed from those of the pulp?**

Diseases of the pericementum respond freely in paroxysms of pain to any pressure brought to bear upon the tooth, while the pulp disorders are demonstrated by the thermal test. Pericemental disorders can always be located by the patient. Pains from pulp affections are more often reflected. When one is complicated by the presence of the other both symptoms may be in evidence.

**At what age is the first permanent tooth erupted, and which tooth is it?**

The first permanent tooth is erupted at about the sixth year; it is called the first molar, or sixth year molar.

**How do you treat hypersensitive dentine?**

In the treatment of hypersensitive dentine the rubber dam should be applied if possible and absolute dryness secured. This, in itself, oftentimes produces sufficient anaesthesia to permit instrumentation. In obstinate cases, however, it may be necessary to employ other therapeutic measures. If the cavity be not deep, a solution of caustic soda (ten grains to the ounce of water) is sometimes effective. A paste of cocaine muriate and glycerine, sealed in the cavity for 24 hours, may be used with good results. Cocaine may also be employed

by cataphoresis. Carbolie acid, chloroform, ethyl or methyl chloride (in spray) are also indicated. In cases of hypersensitivity of abraded teeth (where no cavity exists), the tooth or teeth should be isolated by the rubber dam and strong mineral acids, such as nitric, sulphuric and hydrochloric applied. These agents coagulate the contents of the tubules. The surfaces, treated in this manner, should always be excavated and filled.

**What dangers must be guarded against in the use of arsenic for devitalizing the pulp of a tooth?**

Arsenic, for the purpose of devitalizing the pulp, should be employed with great care. If possible the tooth should be isolated with rubber dam. If carelessly applied, a minute portion of arsenic may come in contact with the gum tissue or be insinuated in the gingival space, producing sloughing of the peridental membrane and gum tissue, or necrosis of the process, or both. Great care should be exercised in sealing arsenic in a cavity to prepare the margins of the cavity in such a way as to permit hermetical sealing. Pastes of arsenic should be applied without an excess of fluid, as there is danger of oozing about the margins during the process of sealing. This drug should never be used for the devitalization of pulps in deciduous teeth.

**Give the differential diagnosis between hyperaemia, inflammation and suppuration of the pulp.**

In hyperaemia the pulp responds to the application of heat or cold in a somewhat exaggerated degree, owing to the dilatation of the vessels. Cases of hyperaemia usually give a history of mild attacks of odontalgia, transient in character. In inflammation of the pulp the response to cold is somewhat diminished; the application of heat produces pain of a severe type. Odontalgia becomes constant, throbbing in character, increasing when the patient assumes a recumbent position. Neuralgic pains may be felt along the course of the fifth nerve. Suppuration begins in the late stage of inflammation, and is

indicated by a cessation of response to cold applications. Heat produces agonizing paroxysms of pain, only alleviated by the immediate application of cold. The pain now assumes a gnawing character, persistently increasing, while throbbing ceases.

**What are saprophytic bacteria, and how do they cause disease?**

Saprophytic bacteria are those forms which flourish upon dead organic substances, effecting their decomposition, and producing poisons, through the agency of which they become causes of disease.

**What objections are there to the premature extraction of the temporary teeth?**

Premature extraction of the temporary teeth is followed by insufficient space for the normal eruption of their permanent successors, resulting in malposed permanent teeth, and, not infrequently, their impaction.

**How do you distinguish erosion of the teeth and caries?**

Erosion is characterized by cupped-out cavities with hard, glossy surfaces usually on the labial aspects of teeth, while caries presents a softening of the tooth structure. Caries may follow erosion.

**How is the destruction of tissue brought about in dental caries?**

The product of lactic fermentation (lactic acid) decalcifies the tooth at a vulnerable point, and the micro-organisms of the mouth attack and destroy the organic remains.

**What is resorption of the roots of deciduous teeth? Is it a physiological or pathological condition?**

Resorption of the roots of deciduous teeth is a physiological process brought about by the phagocytic action of multi-nucleated cells, these cells secrete a ferment, which liquefies the roots, and in this condition they are taken up by the lym-

phatics. In short it is nature's method of preparing a path for the eruption of the permanent successors.

**Describe the pathologic changes which occur in the dental pulp starting from irritation and ending in pus formation.**

Pulp irritation may result from traumatism, excessive thermal stimuli, drug action, or infection. Active hyperaemia of the pulp occurs with a marked dilatation of the arteries and arterial capillaries. If the cause of the irritation is not removed, the white blood-cells in these vessels collect along the walls in great numbers, thereby impeding the flow of the blood stream. If dilatation occurs in the arteries near the apex of the tooth, the return flow of the blood is cut off by an impingement of the engorged arteries upon the apical veins. Diapedesis now occurs and the white blood-cells, together with effusions of inflammation, are poured out into interstitial spaces. This phenomenon marks the onset of pulpitis. If the pulp be infected by pyogenic organisms, the leucocytes are overpowered and die, becoming pus corpuscles.

**Why should deciduous teeth receive early and systematic treatment?**

Deciduous teeth should receive systematic treatment, because their retention in the arch until the time of eruption of their permanent successors, has much to do with the normal eruption of these latter.

**What effect may be produced on the dental pulp by continued mild irritation?**

Continued mild irritation may excite the functional activity of the odontoblasts, thereby producing secondary dentine at the expense of the volume of the pulp and its chamber.

**Give the differential diagnosis between pulpitis and pericementitis.**

Pulpitis is characterized by throbbing pain of a severe



type, aggravated in its early stages by contact with hot or cold substances. The pain is of a reflected type, due to the fact that the pulp has no tactile sense. But very mild response is elicited from percussion. In pericementitis, the tooth is somewhat elongated by a thickening of the inflamed apical pericementum, and responds exquisitely upon percussion.

**Describe the treatment for restoring a sound, superior, central incisor tooth displaced from its socket by violence.**

The tooth should be placed in a solution of bichloride of mercury (1 to 1000) for some minutes, after which the pulp cavity should be cleansed and filled. Replace the tooth in bichloride solution. Now thoroughly cleanse the tooth socket with jets of warm water, removing all clot, and sterilize with stimulating antiseptics such as campho-phenique, etc. Great care must be observed to keep the mouth in an aseptic condition, both during and for a considerable period after the operation. The tooth should be removed with sterile forceps from the solution, and thrust back into its socket without handling. Immobilization may be accomplished by a cap of gold securing it to its fellows, and this allowed to remain until the tooth has become thoroughly fixed.

# THERAPEUTICS AND MATERIA MEDICA.

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**What is meant by idiosyncrasy?**

A peculiar or abnormal response to the action of a drug.

**For what conditions in the mouth is sulphuric acid useful? In what strength and in what manner may it be employed?**

In hypersensitive dentine, in simple cavities of decay, to open and enlarge minute root-canals. In these cases it is employed in 50% strength, applied with a gold probe and neutralized with sodium bicarbonate. In about 10% solutions, it may be employed to remove dead bone.

**In what manner may the teeth be best protected from the effects of acids administered internally through the mouth?**

Acids should be well diluted, taken through a tube, and an antacid at once used to counteract any acidity induced through their use.

**What is a counter-irritant? Name two used in the mouth.**

A counter-irritant is an agent used to excite vascularity where applied, resulting in the relief of pain and vascularity in other parts, e. g. capsicum and tincture of iodine.

**What is the dose of tincture of aconite root?**

One half to five minims.

**What is the local action of aconite?**

It acts as a powerful sedative, causing tingling and numb-

ness, due to paralysis of terminal nerve filaments. Slightly irritating at first.

**What preparation of arsenic is most used in dentistry, and what is the local action of this preparation?**

Arsenic trioxid.

When brought in contact with the tooth pulp we have congestion, accompanied by grumbling pain which in a few hours becomes acute and throbbing. The blood-vessels become strangulated at the apex of the root, resulting in the death of the pulp, with cessation of pain.

**What preparation of iron is particularly injurious to the teeth? Why is it injurious?**

Tincture chloride of iron. On account of the free hydrochloric acid it contains.

**Name the drugs that may be combined with arsenic for devitalizing a tooth pulp, and state what purposes these drugs serve.**

Combined with acetate or sulphate of morphine or hydrochlorate of cocaine, as local anodynes, with an essential oil to make a paste and facilitate the application as well as action.

**Name three local anesthetics used in dentistry, and state the conditions that call for their application.**

Cocaine hydrochlorate, carbolic acid, tincture of aconite. Cocaine hydrochlorate, for hypodermic use in extraction. Carbolic acid, where the sensibility of the gum is to be destroyed to permit of painless incision being made. Tincture of aconite, to allay pain by its application to the gum tissue in cases of pericementitis.

**What desirable qualities should a disinfectant possess for use in a pulp canal?**

Ability to neutralize various products resulting from putrefactive processes, and the attribute of penetrability.

**What conditions about the mouth call for the use of iodine, and what are its effects?**

In pericementitis, oedema of cheeks or lips, as an aid in removing green stain from the surfaces of teeth. Acts as a counter-irritant and stimulates absorption of effusions.

**What conditions about the mouth call for the use of carbolic acid, and what are its effects?**

Full strength acts as a caustic and may be used to touch ulcers. In a 1% or 2% solution, as an antiseptic mouth-wash in stomatitis.

**How should any injurious results arising from the local action of arsenic on the gums be treated?**

By removing all necrotic tissue and touching with an iron preparation or tincture of iodine.

**Name two preparations of opium. State the dose of each.**

Tincture of opium or laudanum. Dose, 5 to 15 minims.

Camphorated tincture of opium or paregoric. Dose, 1 to 4 fluidrachms.

**Of what drugs are morphine and atropine the alkaloids?**

Opium and belladonna respectively.

**Name a physiologic antidote to cocaine.**

Morphine, whisky, or nitrite of amyl.

**For what is permanganate of potassium used in dentistry?**

Ulcer of the mouth with offensive breath, abscesses, diseases of the antrum, necrosis and caries of bone.

**What are the dental uses of the essential oils?**

To obtund hypersensitive dentin, to allay pain in an irritated pulp, to promote antiseptis in septic root-canals and cavities.

**Describe the effect of aconite on the heart and name two other drugs which have a similar effect.**

Small doses decrease the force of ventricular contraction and slow the action of the heart. Large doses cause rapid weak action with tendency to stop in diastole.

Veratrum viride and antimony have a similar effect.

**For what is amyl nitrite used, and how is it administered, and what is the dose?**

Stimulant, particularly in cocaine poisoning. Usually administered by inhalation in three to five minim doses.

**What is the danger of using acids in the mouth? What precaution should be taken?**

They may cause decalcification of tooth structure. They should be followed by antacid washes.

**For what is hydrogen peroxide used?**

To destroy pus, cleanse putrescent pulp-canals, and whenever a germicide, deodorant or disinfectant is required in the mouth.

**Name two escharotics, and state when escharotics should be used.**

Silver nitrate, carbolic acid. Escharotics are employed for the removal of hypertrophied gum tissue. To obtund hypersensitive dentin. In the treatment of ulcerative stomatitis, and to destroy pulp filaments in roots.

**What precautions should be observed in the administration of the general anesthetics?**

Patients should not eat anything for several hours previous, should have bowels thoroughly evacuated, should be placed in a horizontal position, all foreign substances removed from the mouth, clothing loose around the neck and chest, a third party present if the patient be a female, and the anesthetic selected with reference to any organic disease of the patient. Development of dangerous symptoms should be watched for,



and the anesthetic should not be given in an overdose. Re-suscitating means should be at hand.

**Define hemostatic. Give three examples.**

Hemostatics are agents which stop hemorrhage by coagulating albumin and contracting the muscle fibres, *e. g.*, tannic acid, tincture of iron, and adrenalin chloride.

**Mention a medicine whose local action contracts the blood vessels of a part.**

Adrenalin chloride.

**Mention a medicine whose local action dilates the blood vessels of the part.**

Aconite.

**Differentiate disinfectant from antiseptic. Give illustrations of each.**

Disinfectants are agents which destroy the germs of disease. Antiseptics inhibit the growth of micro-organisms and neutralize the toxins, but do not necessarily kill the germs.

Permanganate of potassium (2% solution), bichloride of mercury (1-1000), peroxide of hydrogen are disinfectants.

Boric acid and the essential oils in mild solution act as antiseptics.

**What is the objection to the use of iodoform? Mention three drugs that may be used in place of iodoform.**

Its very objectionable odor. Iodol, aristol and europen may be used in place of iodoform.

**What is the advantage of the cataphoric as compared with the ordinary local application?**

The deeper layers of the dentin and the pulp itself may be affected, whereas the ordinary application could not be made to affect these.

**What two medicines are particularly useful in cataphoric applications?**

Cocaine hydrochlorate to desensitize dentin and pulp, and 25% pyrozone for bleaching.

**Mention (a) three remedies for toothache caused by exposure of the pulp; (b) two remedies for pericementitis.**

(a) Oil of cloves, oil of cinnamon, carbolic acid. (b) Tincture of aconite and tincture of iodine.

**Mention (a) a remedy that antagonizes the constitutional action of aconite; (b) a remedy that increases the constitutional action of aconite.**

(a) Opium. (b) Veratrum viride.

**Mention the dose of two of the preparations of opium, and the dose of one of the alkaloids of opium.**

Tincture of opium, 5 to 20 minims; powdered opium,  $\frac{1}{2}$  to 2 grains; sulphate of morphine,  $\frac{1}{8}$  to  $\frac{1}{2}$  grain.

**Mention the dose of (a) potassium bromide, (b) chloral, (c) acetanilid.**

(a) Potassium bromide, 10 to 60 grains; (b) chloral hydrate, 5 to 20 grains; (c) acetanilid, 2 to 10 grains.

**Mention two heart stimulants that act rapidly, and give the dose of each.**

Aromatic spirits of ammonia, 30 to 60 minims.

Ether, 10 to 60 minims.

**State the action of digitalis on (a) the heart, (b) the blood vessels, (c) the kidneys.**

(a) Increases the force of the heart contractions; lengthens diastole, decreasing the number of beats by stimulation of the pneumogastric.

(b) Raises arterial tension by stimulating vasomotor center, by direct action on the muscular coat and by increasing the force of the heart's contraction.

(c) Dilatation of the renal arteries resulting in an increased flow of urine, without an irritating effect on the renal epithelium.

**What drug is often combined with morphia when given hypodermically? Explain.**

Sulphate of atropine. Atropine being the physiological antagonist, it diminishes the danger of morphia-poisoning.

**Which of the general anesthetics is most depressing to (a) the circulation, (b) the respiration?**

Chloroform to the circulation, and ether to the respiration.

**Mention two medicines that increase blood pressure.**

Digitalis and strophanthus.

**Distinguish between a stimulant and an irritant.**

A stimulant produces increased functional activity. An irritant exceeds the effect of a stimulant and induces venous hyperemia, and possibly inflammation. A stimulant acting continuously may become an irritant.

**With what class of remedies are the coal-tar products prescribed for action on the heart?**

With cardiac stimulants.

**What are the dental uses of the alkalies? Mention three alkalies.**

To counteract any acid condition in the mouth, as in erosion or after acid medicaments. Lime, magnesium, sodium bicarbonate.

**What effect on blood pressure has (a) ether, (b) chloroform?**

Ether increases blood pressure. Chloroform lowers blood pressure.

**State the dental uses of nitrate of silver.**

In the form of lunar caustic it may be used to destroy ulcers in the mouth, or to destroy hypersensitiveness of the dentin; in a 5% or even 10% solution, it is employed in gangrenous stomatitis. In 50% solutions it has been recommended in the treatment of root-canals.

**State, with reference to formaldehyde, (a) its dental uses, (b) the advantages of its use, (c) the objections to its use.**

In mild solutions, in association with other agents, as an antiseptic mouth-wash: in strong solutions, about 5 to 10% of formalin, it is used to disinfect instruments. In the treatment of moist gangrene of the pulp, and wherever a powerful disinfectant is indicated without regard to its intensely irritating effect upon mucous surfaces. It is a powerful disinfectant, and has a hardening effect upon disintegrated organic matter. It is intensely irritating to mucous surfaces.

**State the conditions under which it is more advantageous to give medicines hypodermically than to administer them internally.**

When you wish to produce an immediate effect. When the patient cannot swallow, or is in a condition where absorption from the stomach would take place slowly.

**Mention one drug that contracts the pupil of the eye; one drug that dilates the pupil of the eye.**

Eserine contracts; belladonna dilates.

**State the reasons for or against the use of arsenious acid to obtund sensitive dentin.**

It should not be used to obtund hypersensitive dentin, as it will devitalize the pulp.

**Of what is each of the following an alkaloid (a) strychnine, (b) atropine, (c) morphine. State the dose of each.**

(a) *Nux vomica*, (b) belladonna, (c) opium.

Strychnine,  $\frac{1}{60}$  to  $\frac{1}{20}$  gr.; atropine,  $\frac{1}{150}$  to  $\frac{1}{100}$  gr.; morphine  $\frac{1}{8}$  to  $\frac{1}{2}$  gr.

**What property of tincture of iodine makes it of value in pericementitis?**

Its counter-irritating property, and its ability to stimulate the lymphatics to absorb inflammatory products.

**In what position should the patient be during the administration of chloroform? Why?**

In the recumbent position, to allow of the easy flow of blood to the heart, to counteract the paralyzing influences of chloroform upon the circulation.

**Name four properties that a dentifrice should possess.**

Alkaline, antiseptic, sufficiently coarse to be cleansing, and agreeable flavor.

**What is an antiphlogistic?**

Any therapeutic means of combating the heat of inflammatory reactions.

**What is an escharotic?**

An agent which devitalizes the tissue upon which it acts, producing an eschar or slough.

**Define narcotics and sedatives and give an example of each.**

Narcotics are agents that stimulate and stupefy the brain, allay pain and induce sleep, as opium. Sedatives are agents that depress the nervous centers and allay their irritability or excitability, as bromide of potassium.

**Describe what is meant by an aqueous solution, and write a prescription, giving example.**

An aqueous solution is a drug held in solution with water.

R. Acidi tannici..... gr. x  
Aquæ ..... f℥j  
Sig.—Use as directed.

**What is arsenous acid? Give medical properties and special dental use and antidote.**

Trioxide of arsenic. Internally, in small doses, it acts as an alterative tonic, promoting appetite and digestion, stimulating respiration and circulation, and increasing mental faculties. In dentistry, it is employed to devitalize the pulp. The anti-



dote in cases of poisoning is freshly prepared hydrated ferric oxide.

**Give the medical properties and dose; when indicated in dental practice, and how used; toxic effects, if any; antidotal treatment of each of the following:—Aconite, quinine, naphthol, creasote, oil of cloves.**

Aconite locally paralyzes the terminal sensory filaments, causing numbness and loss of sensibility. Internally, in small doses it depresses respiration and circulation, and in large doses it paralyzes the heart's action. In dental practice it may be used locally to stop pain from an irritated pulp, or as a sedative applied over the gum in pericementitis. Opium, or any cardiac stimulant, together with artificial respiration, is used in cases of poisoning. The dose is 1 to 3 minims of the tincture.

Quinine is a tonic, antiseptic, antipyretic and antiperiodic. It interferes with the function of the red blood-corpuscles and arrests the movements of the white. In small doses it stimulates the brain; in large doses it produces cerebral anemia, ringing in the ears, headache, delirium and coma. The tonic dose is 2 grs., the antipyretic 5-10 grs., and the antiperiodic 10-20 grs. Morphine antagonizes its cerebral action, atropine its cardiac and antipyretic effects. Its use in dentistry is indicated when a patient gives evidence of septic fever through absorption of septic products in cases of acute septic pericementitis or alveolar abscess; in combination with acetanilid and salol, two grains of the sulphate of quinine given every two or three hours will have a controlling effect.

Naphthol is a derivative of naphthalin, and has marked antiseptic properties. In dentistry it is used as hydronaphthol, a powerful antiseptic in a 1 to 200 solution.

Creasote locally acts as an anodyne. Internally in small doses, its action is similar to carbolic acid. It is eliminated by the bronchial mucous membrane, which it stimulates, producing the effects of an expectorant. It is sedative to the mucous membrane of the stomach. In dentistry, it is indi-

icated wherever carbolic acid is used, although the latter is favored because it has not the intensely disagreeable odor of creasote. Dose, 1 to 3 minims in oil.

Oil of cloves belongs to a group of aromatic oils that possess many properties in general. They are antiseptics, stimulants, and local anesthetics. Dose, 1 to 5 minims. In dentistry they are used generally to allay pain in an aching pulp.

**Name three drugs useful in the treatment of empyema of the antrum, and write a prescription containing one such drug in solution.**

Hydrogen dioxide, chloride of zinc, hydronaphthol.

R. Hydronaphthol..... ʒj

Alcohol ..... fʒj

Sig.—Teaspoonful in a wineglass of water.

**Name three heart stimulants administered hypodermically in the order of their rapidity of action. State dose of each.**

Alcohol, strychnine, digitalis.

Alcohol (whisky), 30 to 60 minims.

Strychnia sulphate,  $\frac{1}{60}$  to  $\frac{1}{20}$  gr.

Digitalis (tincture), 5 to 10 minims.

**Define styptic and irritant, and give an example of each.**

A styptic is an agent applied locally to check hemorrhage, like tannic acid. An irritant is an agent capable of drawing an excess of blood to the part upon which it is acting, like iodine.

**Name two drugs that are physiologically incompatible, and two that are chemically incompatible.**

Aconite and morphine, belladonna and opium, are physiologically incompatible. Tannic acid and iron, sulphuric acid and lime, are chemically incompatible.

**Give the dental uses of oil of cinnamon, silver nitrate, aconite, capsicum.**

Oil of cinnamon is used to allay pain in an irritated pulp,

or as an antiseptic application in root-canals. Silver nitrate may be used in the form of lunar caustic to touch ulcers appearing in the mouth, or in full strength to obtund hypersensitive dentin. It has also been recommended, in 50% solution, in the treatment of pulpless canals. Tincture of aconite is used as a sedative application in pericementitis; also, to control an aching pulp, and as an ingredient of ointments for neuralgia. Capsicum is used as a counter-irritant in pericementitis, and as a stimulating ingredient in mouth-washes.

**How is the muscular system affected in complete anesthesia under ether and under nitrous oxide?**

Under ether the muscles are relaxed. Under nitrous oxide the muscles are contracted.

**What are the advantages and disadvantages in the use of chloroform as an anesthetic in tooth extraction?**

The anesthesia resulting from inhalations of chloroform is prolonged, affording free opportunity for the removal of any number of teeth. The disadvantages are decided. The upright position is against the patient; and, furthermore, failure of the heart's action is apt to result in consequence of the irritation of the pneumogastric induced through irritation of the fifth pair of nerves in the extraction.

**What is ethyl chloride? Describe method of producing local anesthesia by its use, and state precautions to be observed.**

Ethyl chloride is a volatile, colorless liquid with a boiling-point of about 60° F. When a spray is directed against tissue it acts as a freezing agent by its very rapid volatilization. The tissue not to be affected should be protected against the spray. By the use of cold applications the tissue may be prevented from too quickly returning to a normal state, and thus lessen the incident pain which is usually felt after the use of chloride of ethyl.

**Give the precautions to be observed before and during the administration of nitrous oxide.**

The patient should be examined as to physical condition, and also as to what teeth or roots are to be extracted, so that no time is lost later. Care should be taken that sufficient nitrous oxide is at hand for the operation, and a third party should be present. The jaws should be kept separated. During the administration, the respiration should be carefully watched. Interference with respiration is the chief source of danger. As soon as the anesthetic state is induced, further administration should at once cease.

**Describe fully two methods for producing local anesthesia.**

Hypodermically, with a 1% or 2% solution of cocaine hydrochlorate, injecting about 20 minims of the 1% or 10 minims of the 2% solution about the alveolar tissue; or by means of a spray of ethyl chloride, protecting the tissues not to be affected. The spray is directed until the tissues whiten. It is better not to allow a too rapid return to a normal condition of the anesthetized parts. This may be produced by directing the patient to hold cold water in the mouth.

**Describe methods of procedure and precautions necessary in hypodermic injections for producing local anesthesia.**

The parts to be operated upon should be treated antiseptically, so that no adherent septic matter is carried into the subtissues. The needle and solution should be perfectly aseptic. Care should be taken not to penetrate a blood-vessel. After injection the fluid should not be allowed to escape. The proper quantity and no more should be injected.

**How is anesthesia modified by age, sex and temperament?**

In children we find a ready response to the inhalation of anesthetics. When ether is used, a hypersensitive mucous

surface in the pharynx and larynx induces coughing; in the aged, chronic bronchial irritation is apt to produce the same result. Women are apt to give manifestations of hysterical tendencies. Sex and temperament may influence the amount necessary to induce anesthesia. The stage of excitement may be prolonged in hysterical subjects, and also in those of bilious attributes.

**What anesthetic do you prefer, and for what reason?**

For the extraction of teeth and minor operations in the mouth that require little time for their execution, nitrous oxide is the safest anesthetic we have at the present time. From a most extended experience during which hundreds of thousands of patients have been placed under its influence, the death rate is practically nil.

**Mention the differences between cocaine and eucaine.**

Cocaine is an alkaloid, soluble to the extent of over 30% in water, decomposes upon boiling, and frequently is followed by poisonous symptoms. Eucaine is synthetically prepared; is soluble to the extent of about 4% in water, does not decompose when subjected to heat, and its use is not so frequently followed by dangerous symptoms.

**At what period in nitrous oxide anesthesia may you have failure in circulation?**

After the anesthetic stage, owing to anemia of the brain.

**What causes the darkened appearance of the patient under nitrous oxide, and state in what manner this may be lessened?**

The accumulation of carbon dioxide. Giving oxygen in combination with nitrous oxide will considerably lessen the bluish appearance of the countenance.

**What is liquid nitrous oxide?**

The gas nitrous oxide liquefies when subjected to a pressure of about 700 pounds at a temperature of about 45° F.



**What is the appearance of the face under ether anesthesia?**

Generally flushed.

**What appliances should be at hand and in readiness when anesthetics are used?**

Hypodermic syringe, with various respiratory and circulatory stimulants. Also the facilities for performing artificial respiration.

**How is bromide of ethyl administered, and what is its action?**

The quantity to be administered is poured out upon a towel (about 2 drachms) and inhaled by the patient. Bromide of ethyl resembles chloroform in its action upon the heart. It interferes with the function of the red corpuscles, and affects consciousness last; in many cases patients are conscious and yet not perceptive of any pain. The anesthesia generally lasts about five minutes.

**What strength of solution of cocaine would you employ for hypodermic use, and how much of the solution would you use?**

Generally 1% or 2% solution is employed. 20 minims of the 1%, or about 10 minims of the 2% solution may be injected.

**Give the antidote of the following drugs, (a) iodine, (b) bichloride of mercury, (c) arsenic, (d) phosphorus.**

(a) Starch, (b) albumin, (c) hydrated ferric oxide (freshly prepared), (d) turpentine.

**Mention two drugs insoluble in water.**

Bismuth subnitrate and mercurous chloride.

**What alkaloids are found in opium? What is its active principle?**

Morphine, codeine, narcotine, thebaine.

The most important active principle is morphine.

**What is meant by a mydriatic? Name one.**

A mydriatic is an agent which causes dilatation of the pupil of the eye, *e. g.*, belladonna.

**What is meant by a synergist? Name the synergists of aconite.**

A synergist signifies an aid. *Veratrum viride*, tartar emetic or bromide of potassinn act as synergists to aconite.

**What is a cathartic, and how are cathartics divided?**

Cathartics are agents which produce evacuation of the intestinal tract. They may be arranged according to the severity of the effect. Laxatives are the mildest, purgatives are more severe, and drastics most severe in their action.

**Give the treatment of poisoning from cocaine.**

Fresh air, inhalations of nitrite of amyl or ammonia. Alcohol, (brandy or whisky,) aromatic spirits of ammonia, strychnine, digitalis and atropine, hypodermically or by the mouth. External heat.

**State the local action of cocaine on the blood vessels.**

Cocaine applied to a mucous membrane or injected under the skin causes the blood-vessels of the part to contract. As the effect passes off, the reaction results in dilatation.

**Name three mineral acids employed in dentistry and give their properties and uses of each.**

Hydrochloric Acid.—The strong acid is a powerful caustic and escharotic; also disinfectant and fumigant. The dilute acid is tonic, refrigerant and astringent.

The strong acid is employed as a local application in gangrenous stomatitis, or cancrum oris, for arresting the ulcerative process. Combined with equal parts of glycerine it is useful in inflammation and ulceration of the oral mucous membrane; also in cases of sloughing. In aphthous ulceration of the mouths of children, it is often useful.

Nitric Acid.—Pure nitric acid is a powerful caustic and

escharotic. The dilute acid is an antalkaline, alterative, tonic and refrigerant.

The strong acid, when mixed with two parts of hydrochloric acid, is a solvent for gold. It is employed as a caustic in cancrum oris; also for malignant ulcers of the mouth and for devitalizing pulp of teeth when nearly exposed by mechanical abrasion.

**Sulphuric Acid.**—The strong acid is a powerful escharotic, the dilute acid is refrigerant, astringent and tonic. The concentrated sulphuric acid is used as a caustic in malignant ulcers, cancrum oris and gangrene in the form of a paste, made by mixing it with powdered sulphate of zinc. It is also used to cleanse metal plates. The dilute acid or the aromatic sulphuric acid which is more agreeable, is used in pyorrhœa alveolaris, and in caries and necrosis of the maxillary bones, as an injection or lotion. It is also employed in cases of recession of the gums and absorption of the processes. It is valuable in alveolar abscesses as an injection. It is employed in stomatitis and ulcers of the mouth.

**Mention (a) two heart stimulants, (b) two heart sedatives. State the dose of each.**

(a) Aromatic spirits of ammonia, 20 minims to 1 drach. Whisky, 2 drachms to 1 ounce.

(b) Tincture of aconite, 1 to 5 minims. Tincture of veratrum viride, 3 to 30 minims.

**Mention three medicines used to produce emesis and state how each is administered.**

Sulphate of zinc, 10-30 grs. by mouth.

Mustard, 1 to 2 drs. by mouth.

Apomorphine hydrochlorate,  $\frac{1}{16}$ — $\frac{1}{8}$  gr. hypodermically.

**Mention three medicines used to produce diaphoresis.**

Pilocarpine, tartar emetic, and Dover's powder.

**What is the local action of chloroform?**

Placed on the skin and allowed to evaporate it produces a

sensation of cold. If the vapor be confined it causes irritation with redness and even vesication, accompanied by a sensation of heat, followed by numbness and a decreased sensation of the part.

**Define *materia medica*, therapeutics.**

*Materia medica* treats of the source of drugs, their physical and chemical properties, and may also include their physiological action.

Therapeutics treats of the application of remedial agents to disease.

**In what ways may medicines enter the system?**

Mouth, rectum, respiratory tract, absorbed through the skin and injected under the skin.

**Name two drugs whose poisonous action is markedly manifest in the mouth. Give the distinguishing characteristics of the effects of these drugs.**

Iodides and mercury.

Iodism is manifest by swelling and redness of the gums, fauces, hard and soft palate, foulness of the tongue, fetid breath, and increase of mucus in the mouth; also headache, coryza and increased bronchial secretion. Mercury may increase the salivary flow to several pints per day. At first the secretion is thick, but later becomes thin. Fetid breath, sore gums, may go on to ulceration of the month and cheeks. Low fever.

**Which of the vital organs fails first in collapse from (a) ether, (b) chloroform?**

(a) Kills by paralysis of respiratory center, (b) usually the heart, but may be respiratory center.

**Name two medicines that decrease blood pressure.**

Tartar emetic and tincture of aconite.

**Describe the method of administering a medicine by which its quickest action is obtained.**

The medicine in solution is placed in a hypodermic syringe

(the syringe and solution being as near aseptic as possible). The air is expelled while the needle points upward, sterilize the skin and inject contents into the cellular tissue.

**Define diuretic, diaphoretic, expectorant.**

Diuretics are agents which increase the flow of urine. Diaphoretics increase the perspiration. Expectorants increase and modify the secretion of the bronchial mucous membrane.

**Differentiate a tonic and a stimulant.**

Tonics promote secretion and give tone to the system. Stimulants increase the function of the part or organ.

**Mention two medicines that may be used as cauteries.**

Nitrate of silver and carbolic acid.

**State the treatment of carbolic acid poisoning.**

Administer a soluble sulphate (sodium or magnesium) and follow by albumin and mucilaginous drinks. Wash out the stomach. Combat collapse by external heat and with hypodermic injections of strychnine and atropine.

**What is an emetic?**

Emetics are agents which excite vomiting either by local or central action.

**Mention two drugs that reduce fever.**

Acetanilid. Quinine.

**Describe the symptoms of cocaine poisoning.**

A rapid, feeble and irregular pulse, with shallow and labored respiration, clammy skin, dilated pupils, delirium and hallucinations. May have clonic convulsions and increased temperature.

**What restoratives are most desirable in case of threatened collapse during the administration of (a) Nitrous Oxide, (b) Ether, (c) Chloroform.**

(a) Amyl nitrite, oxygen, atropine.



(b) Ammonia, oxygen, strychnine, atropine and faradic current.

(c) Ammonia, strychnine and digitalis.

**What is the antidote for opium?**

Potassium permanganate (chemical). Atropine (physiological).

**What is the dose of bichloride of mercury?**

$\frac{1}{60}$  to  $\frac{1}{12}$  gr.

**Mention two purposes for which medicines may be applied cataphorically in dentistry.**

For painless tooth extraction, and to antisepticize pulp-canals.

**What medicines are indicated and about how long should they be applied cataphorically for the purposes mentioned in the preceding question.**

(a) Cocaine, (b) silver nitrate, 8 to 20 minutes.

**Mention three saline cathartics and state the dose of each.**

Sulphate of magnesia (Epsom salt), 1 drachm to  $1\frac{1}{2}$  ounces.

Tartar of potassium and sodium (Rochelle salt), 1 drachm to 1 ounce.

Solution of citrate of magnesia, 12 ounces.

**Mention three good counter-irritants.**

Cantharides, tr. of iodine, and mustard.

**Define chemical antidote for a poison, physiological antidote for a poison.**

By chemical antidote is meant some substance which combines chemically with the poison, producing an inert or insoluble compound. By physiological antidote is meant a substance which is opposed to the poison in its action on the economy.

**State three properties of carbolic acid.**

Local anesthetic, caustic and antiseptic.

**Name the antacids valuable for use in the mouth.**

Sodium bicarbonate, lime-water, chalk and charcoal.

**What is the chief use of capsicum in dentistry?**

As tincture or plaster in periodontitis.

**What is meant by chemical and physiological incompatibility of medicines?**

Agents are said to be chemically incompatible when their mixture results in the decomposition of one or more of the ingredients.

Physiological incompatibility is where one drug produces effects upon the system opposite to the action of some other drug, like aconite and opium.

**Give the physiological action of belladonna.**

Belladonna is an anodyne, an antispasmodic, a mydriatic, an irritant narcotic; in small doses a respiratory, cardiac, and spinal stimulant; in large doses a paralyzer of the secretory and motor nerve endings, and a stimulant of the sympathetic system. It produces dryness of the mucous membranes of the nose, mouth, throat and larynx; and at first lessens the gastric and intestinal secretions, but soon reproduces them in large quantity. The heart-rate is at first slowed, but soon becomes vigorous and rapid.

**Give the mouth signs of mercurial poisoning.**

Hyperemic mucous surface, teeth tender upon pressure and loose, increased flow of saliva, swollen tongue, and metallic taste.

**How should the administration of chloroform differ from that of ether?**

Chloroform should be administered a few drops at a time and the vapor allowed to mix freely with air, while ether is administered in larger quantities and only a small amount of air allowed to mix with the vapor.

**State the objection to the use of iron salts as styptics.**

The clot which is formed is soluble in the fluids of the mouth, frequently resulting in secondary hemorrhage. Iron solutions used are also strongly acid.

**Mention, with doses, three coal-tar preparations, useful in the treatment of neuralgia.**

Acetanilid, 2 to 10 grs.; phenacetin, 2 to 10 grs.; anti-pyrine, 5 to 10 grs.

**Differentiate poisoning by atropine and poisoning by strychnine.**

In atropine poisoning we have motor paralysis, delirium and death. In strychnine poisoning we have convulsive action of the muscles with consciousness. Death follows from exhaustion and asphyxia.

**Write a prescription for an antiseptic mouth-wash.**

R    Acidi carbolici (95%)..... m xxx  
       Aque ..... q. s. f.  $\frac{3}{4}$  v  
       Sig.—Use as mouth-wash.

**What is meant by the active principles of a drug? Give an example.**

The extractive substance which gives the drug its medicinal properties. Quinine is an active principle of cinchona bark.

**Mention three alteratives.**

Arsenic, mercury and iodine.

**Give the physiological action of ergot.**

Externally it acts as a slight astringent on the broken skin or mucous membrane.

Gastro-intestinal Tract.—Disagreeable taste and may produce nausea and vomiting.

Circulation.—Heart-beat becomes slow and increased in force. It stimulates the vaso-motor center and unstriated muscular fibres of arteries, raising blood-pressure.

Uterus.—It stimulates the contraction of the parturient

nterus, increasing the force and frequency. There is a marked decrease in the blood-supply of the non-parturient uterus.

Nervous System.—It causes anemia of the centers, particularly in the spinal cord.

**Give the physiological action of digitalis.**

Gastro-intestinal Tract.—Digitalis may cause nausea, vomiting and diarrhœa.

Circulation.—Decreases the number of heart beats, lengthening diastole (stimulation of inhibitory fibres of vagus). It increases the force of the contractions (intrinsic ganglia). Arterial tension rises from increased cardiac force, excitation of vaso-motor center, and direct action on the muscular coats of the arteries. By relaxation of renal arteries it increases flow of urine. Later the heart becomes weak and irregular, beating with increased frequency. Large doses decrease abnormal temperature. It may cause headache, vertigo or delirium. It also stimulates the uterine contractions.

**Give the physiological action of nux vomica.**

Gastro-intestinal Tract.—Small doses act as a bitter tonic, increasing appetite, secretion and digestion. It increases the muscular tone of the stomach and peristalsis is also increased.

Circulation.—Cardiac center, vaso-motor center and cardiac ganglia are stimulated, raising arterial tension, increasing the force of heart action but slowing its beat. The respiratory center is stimulated, the pupils dilated, the contractile power of the bladder is stimulated, the reflex activity of the spinal cord is increased. It also acts as an aphrodisiac.

**Give the physiological action of opium.**

Externally it is slightly sedative.

Stomach.—It decreases sensation, secretion and peristalsis, reducing hunger and pain. Continued use deranges digestion.

Intestines. — Sedative action, relieving pain, secretion decreased and peristalsis is decreased by stimulation of the splanchnics (inhibitory nerves). Large doses may cause diar-

rhœa leading to paralysis of the splanchnics. Bile and pancreatic juice are decreased.

**Nervous System.**—The convolutions of the brain are briefly excited, then depressed by direct action on nerve cells (possibly by causing anemia).

**Stage of Excitement.**—Exaltation of feelings, happiness, brilliancy of imagination, increase of intellectual power and mental vigor. Imagination becomes extravagant, dreams of grotesque and impossible things. Sensory and perceptive centers become depressed, stupor and sleep. Pupils contracted.

**Write a complete prescription for a four-ounce aqueous solution containing three drugs. (b) State the amount of each drug contained in a teaspoonful of the solution.**

FOR JOHN SMITH.

℞. Potassii bromidi ..... gr. clx  
Chloralis ..... gr. lxiv  
Tincturæ digitalis ..... m. xlviij  
Aquæ, q. s. ad. .... f̄ssiv

M. Sig.—Teaspoonful in water every hour until relieved.

10-29-'04.

Dr. D——.

(b) Potassium bromide, 5 grs.; chloral, 2 grs.; tincture of digitalis, 1½ minims.

**Under what conditions is ether contra-indicated as an anesthetic?**

In acute inflammatory infections of the respiratory tract, advanced arteriosclerosis, severe nephritis, especially when associated with cardiovascular lesions and anemia when the hemoglobin is less than 30%. Diabetes mellitus, especially when well established and associated with acetonuria (Stevens).

**Name the most common after-effects of the administration of ether.**

Nausea and vomiting.

**Name the accidents that may happen during the administration of ether, and give the treatment in each case.**

In the early part of the administration of ether we may



have failure of respiration, which is due to reflex spasm of the laryngeal muscles excited by the ether. By giving more air with the ether we can correct this trouble.

Embarrassed respiration may be due to the accumulation of mucus in the upper air-passages. In this condition we simply turn the head to one side.

Respiratory failure may be caused by the action of the ether on the respiratory center. In this case we withdraw the ether; push the jaw forward by pressing on its angles, draw the tongue forward by means of a tenaculum or forceps and make rhythmic traction of the tongue. Pour ether on the abdomen or chest in order to stimulate inspiration by reflex action, give strychnine and atropin hypodermically. Practice artificial respiration.

**When is chloroform preferred to ether as an anesthetic?**

In acute inflammation of the bronchi or lungs, aneurism, atheroma and nephritis.

**Give the signs of danger in chloroform anesthesia and tell what should be done.**

Lividity of the face, irregular or stertorous breathing or feebleness of the pulse. Withdraw the anesthetic, lower the head, use artificial respiration and give a hypodermic injection of strychnine, digitalis, or ammonia.

**What are topical remedies? (b) Mention two classes. (c) Give two examples of each.**

Topical remedies are those which are applied locally.

(b) Plasters and liniments.

(c) Belladonna plaster and capsicum plaster—turpentine liniment and chloroform liniment.

**What systemic conditions contra-indicate the use of nitrous oxide gas? (b) State why?**

Atheromatous vessels, fatty heart and pulmonary emphysema (Burchard).

(b) Nitrous oxide gas increases blood pressure, and in

atheromatous degeneration of the arteries this may result in rupture of these vessels, and if in the brain, apoplexy or early death may ensue.

In fatty heart the muscles are weakened, and on account of the increased resistance in the blood-vessels there may be sudden dilatation of this organ.

In pulmonary emphysema the danger is in the engorgement of the blood-vessels of the lungs, which causes an increased resistance to the right heart, which may result in the sudden dilatation of this organ, or there may be pulmonary edema or hemorrhage.

**Give the indications for the use in producing sleep of (a) morphine, (b) chloral, (c) potassium bromide.**

(a) Morphine is used when sleeplessness is due to pain.

(b) Chloral is indicated when sleeplessness is due to mental overwork and where a more powerful hypnotic than potassium bromide is required. If the heart or stomach are in bad condition it should not be given.

(c) Potassium bromide is given when insomnia is caused by cerebral excitement, nervous excitement (especially when connected with the genital function) and motor activity. According to Wood it is contra-indicated by an excessive irritability of the gastro-intestinal mucous membrane and great exhaustion.

**What is an analgesic? Mention three.**

An analgesic or anodyne is an agent which relieves pain. This may be accomplished by local or central action. Opium, cocaine and chloroform are examples.

**Why is the use of ether as an anesthetic contra-indicated in diseases of the lungs and kidneys?**

Because it is eliminated by the lungs and kidneys, and on account of its irritating qualities it would aggravate the diseased condition.

**Describe the three stages of chloroform narcosis.**

1st stage.—This stage is very short and the symptoms are

very similar to those of alcoholic intoxication. Consciousness is not lost but the sensibility is generally dulled, but rarely altogether abolished.

2d stage.—This is the stage of anesthesia; consciousness and sensibility are abolished, the muscles are relaxed and the patient is quiet. The pulse is generally normal in frequency, but somewhat weakened.

3d stage.—This stage is one of profound narcosis, with stertorous breathing, intense muscular relaxation, abolition of the ordinary reflexes, and fall of bodily temperature. Pulse is weak and rapid.

**Give the contra-indications to the use of anesthetics.**

Organic brain disease, including tumors, atheromatous conditions of the blood-vessels, organic affections of the heart, lungs and kidneys (Wood). Some authorities add diabetes mellitus, chronic alcoholism and enlarged tonsils.

**Describe the three stages of anesthesia under ether.**

1st stage.—Burning the fauces, feeling of strangulation, sense of exhilaration, lightness in the head with a buzzing or roaring in the ears. These symptoms are soon followed by a feeling that the surroundings of the patient are at a distance, which fades into semi-unconsciousness with visions and illusions. Patients may laugh, shout, weep, fight or pray.

2d stage.—This stage begins with a complete loss of consciousness. Muscular rigidity soon passes off and the patient is quiet. Respiration is slow and regular.

3d stage.—Same as the third stage under chloroform narcosis.

**Name the ingredients of a desirable dentifrice and specify the properties that make each of these ingredients desirable.**

Precipitated chalk gives body, is abrasive and also antacid. Orris root gives flavor and masks the soap.

Powdered soap is antiseptic and removes fatty film from the teeth.

Saccharine sweetens, and disguises earthy taste of chalk.  
Menthol is strongly antiseptic and cooling.

**What is meant by cataphoric application of a remedy?**

By cataphoric application of a remedy is meant the infiltrating of the tissue with some drug by electrical osmosis.

**Differentiate a decoction, an infusian and a tincture.**

Decoctions are solutions of the active constituents of drugs obtained by boiling them with water.

Infusions are aqueous solutions of the medicinal constituents of plants, obtained by infusing the drug with hot water, the drug not being subjected to boiling.

Tinctures are solutions of non-volatile substances in alcohol.

**Differentiate fixed oils and volatile oils and give three examples of each.**

Fixed or fatty oils are permanent liquids, or at certain temperatures solid substances, not volatilized by heat, and leave greasy stain on paper. They consist mainly of varying proportions of olein, palmitin, stëarin.

Castor, linseed and olive oils belong to this class.

Volatile or essential oils, so called because they usually represent the odorous principles of plants, are entirely dissipated by exposure to the air or heat. They leave no stain on paper, have hot, pungent taste, but when diluted are agreeably aromatic. They consist of two principles—a solid stearopten, and a liquid eleopten portion. They are limpid fluids at ordinary temperatures. Oils of cloves, wintergreen and cinnamon belong to this class.

**What is hydrogen dioxide? Give its formula and dental uses?**

Hydrogen dioxide (U. S. P.) is a slightly acid, aqueous solution containing, when freshly prepared, about 3% by weight of the pure dioxide, corresponding to about 10% of available oxygen. Formula is  $\text{H}_2\text{O}_2$ . Its dental uses are to destroy pus and whenever a non-toxic disinfectant is indicated.

**What is iodoform? Give a solvent and state dental uses.**

Iodoform occurs as small, lemon-yellow crystals of a very persistent, disagreeable odor, made from the action of iodine on alcohol with potassium hydrate or carbonate. It is almost insoluble in water, very soluble in alcohol, ether, chloroform, fixed and volatile oils. In dentistry it is employed as a root-canal dressing.

**What is formaldehyde? State the dental uses and the strength of solution that should be used for each purpose.**

Formaldehyde is a colorless, irritating gas, produced by the oxidation of methyl-alcohol. It is very soluble in water and alcohol, and occurs commercially as a 40% aqueous solution. It is used in dentistry in mouth-washes as an antiseptic in  $\frac{1}{4}$  to 1% solution.

**Write two complete prescriptions, one containing a drug in aqueous solution and the other containing a drug insoluble in water, also in solution.**

FOR MISS JONES.

R. Plumbi acetatis..... gr. v  
 Aquæ dist. .... f $\overline{3}$ j  
 M. Sig.—Use as directed.

J. V. DOE.

FOR MISS ———.

R. Hydronaphthol..... ʒj  
 Alcohol ..... f $\overline{3}$ j  
 M. Sig.—Teaspoonful in wineglass of water, as a wash.

J. V. DOE.

**What are fluid extracts?**

They are liquid, alcoholic preparations of drugs, permanent and concentrated to such a strength that 1 c.c. represents the equivalent of one gram of the drug.

**What is bromide of ethyl?**

Bromide of ethyl is a colorless, volatile liquid with ethereal odor. Made by distilling a mixture of potassium bromide, alcohol and sulphuric acid and purifying the distillate.



**Distinguish between narcotics and hypnotics.**

Narcotics are drugs, all more or less poisonous, which depress the higher functions, lessen, and in large doses abolish sensibility to pain and cause sleep, which is usually followed by unpleasant symptoms.

Hypnotics induce refreshing sleep with no untoward after-effects. They are cerebral sedatives.

**Write a prescription for a wash for a purulent antrum, using no proprietary terms.**

R. Sodium bicarbonate.....	gr. xxx
Thymol .....	gr. v
Alcohol .....	f℥iv
Glycerine .....	f℥i
Water, q. s. ....	f℥iv
M. Sig.—To be used as directed.	

**Mention two heart stimulants administered by inhalation and state under what circumstances they are particularly useful.**

Amyl-nitrite—in chloroform anesthesia should cardiac failure occur.

Ammonia—in syncope from any cause.

**What physical states of medicine are most suitable for different methods of administration?**

By mouth—solution, pill, powder or capsule.

By innunction—liniment, ointment or plaster.

By inhalation—vapor.

By rectum—solution or suppository.

By hypodermic injection—always in solution.

**Write a prescription for an astringent mouth wash, using no proprietary terms.**

R. Sodium bicarbonate.....	gr. xxx
Tincture of iodine .....	f℥j
Tannic acid .....	gr. xxx
Water .....	f℥vi
Sig.—To be used as a mouth-wash as directed.	

**Mention three disinfectants suitable for use in putrescent pulp canals.**

Formaldehyde. Carbolic acid. Bichloride of mercury.

**Mention a chemical antidote for carbolic acid.**

Magnesium sulphate.

**Define germicide, deodorant.**

Germicides are agents that destroy germs.

Deodorants cover or destroy disagreeable odors.

**How do drugs produce emesis?**

Drugs produce emesis by acting on the stomach directly, afferent impulses stimulating the vomiting center in the medulla, and by stimulation of the center in the medulla itself.

**Write a complete prescription calling for three drugs which may be suitably combined.**

R. Acetanilid..... ʒj  
Sodium bicarbonate .....  
Caffeine.....â gr. xv  
M. et ft. chartae no. xii.  
Sig.—Take one every two hours.

**Define antipyretics. Mention three.**

Antipyretics are drugs which reduce temperature when abnormally high by retarding oxidation, by increasing heat dissipation, or by acting either on the heat-producing center of the brain or on the circulation.

Acetanilid. Aconite. Quinine.

**Mention, with the dose of each (a) saline cathartic, (b) laxative cathartic, (c) cholagogue cathartic.**

(a) Magnesium sulphate, dose 2 to 8 drams.

(b) Cascara sagrada (fluidextract), 15 to 60 minims.

(c) Calomel in large doses, 2 to 10 grs.

**Mention three medicines used as styptics.**

Alum. Tannic acid. Solution of ferric subsulphate.

**Mention a medicine that stimulates absorption by the lymphatics.**

Potassium iodide.

**Mention three essential oils and state their dental uses.**

Oil of cinnamon—antiseptic root-canal dressing.

Oil of cloves—to relieve toothache.

Oil of wintergreen—for its agreeable taste and antiseptic qualities in dentifrices.

**Mention two agents used in bleaching teeth and describe the method of their application.**

Sodium dioxide, if placed in a moist cavity, liberates nascent oxygen, thereby bleaching the dental tissue. Twenty-five per cent. pyrozone has similar action.

**What remedies, general or local, aside from operative procedure, are useful for the relief of toothache? (a) when the pulp is alive and not exposed? (b) when pericementitis has supervened on death of the pulp.**

(a) Oil of cinnamon. Oil of cloves. Tincture of aconite given internally in  $\frac{1}{2}$ -drop doses.

(b) Tincture of aconite and tincture of iodine in equal parts applied to the gum over the affected tooth.

**In death from ether, which of the vital organs fail first?**

The organs of respiration.

**Mention (a) a coagulating antiseptic, (b) a non-coagulating antiseptic.**

(a) Carbolic acid. (b) Oil of cinnamon.

**Define astringents. Mention two vegetable and two mineral astringents.**

Astringents are remedies which cause contraction of muscular tissue, coagulate albumen and lessen secretions from mucous surfaces. In weak solutions they act as tonics; in concentrated form they act as irritants and caustics.

Vegetable astringents, tannic acid, krameria.

Mineral astringents, alum, iron subsulphate.

**Define sialagogue. Mention one.**

Sialagogues increase the action of the salivary glands.  
Pilocarpine.

**Mention three alteratives and state the dose of each.**

Mercuric bichloride,  $\frac{1}{32}$  to  $\frac{1}{16}$  gr.

Potassium iodide, 5 to 60 grs.

Fluidextract of stillingia,  $\frac{1}{4}$  to 1 fluidrachm.

**What is meant by the physiologic action of a drug?**

The physiologic action of a drug is the altered action, function, and behavior of the tissue and organs while under its influence.

**Arrange the following in the order of their efficiency as disinfectants; carbolic acid, bichloride of mercury, oil of cloves.**

Bichloride of mercury. Carbolic acid. Oil of cloves.

**Mention the drugs useful in the treatment of pyorrhea alveolaris and state their effects.**

*Hydrogen peroxide* attacks pus and dead tissue vigorously, destroying them by the liberation of oxygen.

*Hydro-naphthol* is an efficient germicide for use after pus pockets have been otherwise cleansed.

*Aromatic sulphuric acid* is useful to soften and remove calcareous deposits, besides having marked antiseptic and stimulating properties.

**Describe the physiological action of amyl-nitrite. State the dose and the method of administering it.**

Amyl-nitrite stimulates the rate of heart-beats, though not their force; vessels dilate, causing fall in arterial tension; the respiration is first stimulated, but later depressed; action on the nervous system—great depression of motor centers; temperature falls.

The dose is three to five minims dropped on a napkin and administered by inhalation.

**What is cocaine hydrochlorate? How is it obtained? State its properties and dose.**

Cocaine hydrochlorate is an alkaloid obtained from the leaves of *Erythroxylon Coca* by removing the tannin from an aqueous infusion of the drug with lead subacetate, and the addition of sodium or potassium hydrate to alkalinity. Then it is agitated with ether and the ethereal portion evaporated. It is finally purified by repeated crystallization from alcoholic solutions after having neutralized the salt with hydrochloric acid. It occurs as colorless, transparent, odorless, neutral crystals, bitter to the taste. It is soluble in half its weight of water or alcohol, less soluble in chloroform, and almost insoluble in sulphuric ether. It acts first as a stimulant, but later as a narcotic and depressant. Dose,  $\frac{1}{8}$  to  $\frac{1}{2}$  gr.

**How many grains of a drug are necessary to make one pint of a 1 to 2000 solution? Write a prescription for a 1 to 2000 solution of bichloride of mercury.**

A pint of water weighs 7291.2 grains. A 1 to 2000 solution contains  $\frac{1}{2000}$  of a grain in every grain of water. Therefore,  $\frac{7291.2}{1} \times \frac{1}{2000} =$  number of grains in a pint of the solution; or 3.6456 grains.

R. Bichloride of mercury..... gr. 3.6456

Distilled water ..... f $\overline{3}$  xvi

M. Sig.—Use as directed.

**Name three drugs useful for sterilizing instruments. Describe a method of sterilizing a mouth-mirror.**

Formaldehyde. Carbolic acid—5% solution. Hydrogen dioxide.

Sterilize a mouth-mirror by immersing it in a 10% solution of formaldehyde for at least fifteen minutes.

**Name three heart stimulants administered hypodermically in the order of their rapidity of action and state dose of each.**

Strychnine sulphate, dose  $\frac{1}{20}$  gr.

Nitroglycerine, dose  $\frac{1}{100}$  gr.

Alcohol, dose 30 minims.



**What remedies should always be at hand to meet symptoms of danger in giving anesthetics?**

Aromatic spirits of ammonia; hypodermic tablets of strychnine sulphate; amyl-nitrite; tincture of digitalis; alcohol (whisky or brandy); nitro-glycerin; atropine.

**Give maximum dose of cocaine hydrochlorate for hypodermic administration to an adult.**

One-half grain.

**Describe carbolic acid and cresote. (a) Where derived? (c) Their dental use.**

*Carbolic acid* occurs as clear, colorless (when fresh) interlaced, needle-like crystals, which, after exposure to light acquire a pink to reddish tint. It liquefies by heat or on addition of 10% of water or glycerine; has distinctive, slightly aromatic odor, and when diluted has a sweetish pungent taste. It has faint acid reaction, is soluble in alcohol, glycerine or water, and coagulates albumin. Carbolic acid is obtained from coal-tar by fractional distillation and subsequent purification. In full strength it is used for hypersensitive dentin, and in pulpitis as an anodyne. In carious cavities and putrescent pulp-canals it is useful as a germicide, antiseptic dressing, and as a caustic in treating ulcers. A 5% solution may be used as an antiseptic for sterilizing instruments, and in weaker solution as an antiseptic mouth-wash.

*Creosote* is an almost colorless, highly refractive, oily liquid, turning red or brown on exposure to light. Its odor is penetrating and smoky, with burning caustic taste. It is slightly soluble in water, fully so in alcohol, chloroform, ether and oils; does not coagulate albumin.

It is derived from the fractional distillation of wood-tar, that portion coming over between 205 and 220 degrees (Centigrade) being collected as creosote. Its dental uses are very similar to those of carbolic acid, though not suitable for sterilizing instruments nor as a mouth-wash, because of its insolubility in water.

**Write a prescription for a counter-irritant containing three drugs.**

R. Tincture of aconite  
 Tincture of iodine  
 Chloroform ..... āā f 3j  
 M. Sig.—Apply as directed.

**How do cocaine and eucaïne differ in physiological action?**

Eucaïne has a very similar action to cocaine but does not dilate the pupils nor interfere with accommodation. It does not affect the circulation nor respiration to any great extent as does cocaine.

**Name five essential oils used in dental practice.**

Oil of cinnamon, oil of cajuput, oil of cloves, oil of winter-green, oil of eucalyptus.

**(a) What are local anesthetics? (b) Mention three. (c) Describe the method of using them. (d) State the precautions necessary.**

(a) Local anesthetics are agents which produce insensibility of the part to which they are applied.

(b) Cocaine hydrochlorate, ethyl chloride, carbolic acid.

(c) Cocaine hydrochlorate is used hypodermically in 1 to 5% solution. Ethyl chloride is used as a spray. Carbolic acid is applied to the surface in solutions up to 10% for its benumbing effect, which lasts several hours.

(d) In the use of cocaine hydrochlorate hypodermically, have the syringe and solution perfectly aseptic, taking care not to inject an overdose. Have triturates of  $\frac{1}{200}$  grain of atropine sulphate always at hand, also morphine sulphate as antidotes.

In the use of ethyl chloride care should be taken not to freeze the tissue too hard.

In carbolic acid as an anesthetic, solutions stronger than 10% irritate and have caustic effects.

**What is trichloroacetic acid? (b) What are its properties and dental uses?**

(a) It occurs as colorless crystals, very soluble in water, obtained by the oxidation of chloral by nitric acid.

(b) It is of value in the quantitative estimation of albumin and as a caustic. Its dental uses are as an aid in removing calcic deposits, and in treatment of suppurating surfaces.

**Describe the properties, dental use and application of copper sulphate.**

Copper sulphate occurs in large, blue crystals, permanent in the air, is odorless, and has a bitter, metallic taste; it is soluble in about three parts of water. In strong solution it acts as a caustic and in dilute form as an astringent. Internally in doses of 5 to 10 grs. it is a certain and powerful emetic.

Dental use—valuable for its astringent properties.

**(a) From what is opium obtained? (b) Name two of its alkaloids. (c) State the adult dose of each.**

(a) Opium is the inspissated milky exudate obtained by the incision of the unripe capsule of *Papaver Somniferum*.

(b) Alkaloids—morphine and codeine.

(c) Dose—morphine,  $\frac{1}{8}$  to  $\frac{1}{2}$  gr.; codeine,  $\frac{1}{4}$  to 2 grs.

**Write a prescription for the treatment of thrush, containing at least two drugs and a menstruum.**

R. Boracic acid..... ʒj  
 Carbolic acid ..... m v  
 Glycerine  
 Water ..... āā f ʒ iv  
 Sig.—Use as a wash.

**How many grains of a drug are there in six fluid ounces of a 10% solution?**

A fluidounce of distilled water contains 455.7 gr. Six fluidounces therefore contain 2734.2 gr.

A 10% solution must therefore contain  $\frac{2734.2}{10}$ , or 273.42 gr.

**What is the dose of carbolic acid for internal administration? What are the chemical antidotes?**

Dose is  $\frac{1}{2}$  to 2 grs.

Chemical antidotes—albumin and sulphate of sodium or magnesium.

**Describe the action of a saline cathartic. Name three and give the dose of each.**

Saline cathartics act by generally stimulating the secretion of intestinal fluids. This, together with increased peristaltic movements, results in easy evacuation.

Magnesium sulphate; dose,  $\frac{1}{4}$  to  $1\frac{1}{2}$  ounces.

Potassium and sodium tartrate; dose,  $\frac{1}{4}$  to 1 ounce.

Sodium phosphate; dose,  $\frac{1}{4}$  to 1 ounce.

**Define diffusible stimulants. (b) Give three examples and mode of administering each.**

Diffusible stimulants are stimulants which have a prompt but transient effect.

Ammonia—by inhalation.

Ether—by mouth or hypodermic injection.

Alcohol—by mouth or hypodermic injection.

**Write a prescription containing an anodyne, a styptic, and an antiseptic to be used after extensive extraction of teeth.**

FOR MRS. CARPENTER.

R. Acidi tannici .....	ʒ ii
Acidi carbolicæ .....	gr. xxx
Sodii hydratis.....	gr. xv
Glycerini .....	fʒ iv
Aquæ .....	fʒ iiii

M. Sig.—Use as a mouth-wash.

DR. ———.

**Give a rule for determining the amount of a drug required to prepare a solution of a given percentage.**

Multiply the amount (expressed as grains) of the finished solution by the per cent. given, and divide by one hundred.

The quotient will be the quantity in grains of the drug required.

**In what order are the nerve centres affected in general anesthesia?**

Nerve centers affected in general anesthesia are the brain, sensory side of spinal cord, motor side of spinal cord, and finally the nerve centers in the medulla.

**What are the physiological effects of nitrous oxide gas?**

It is a stimulating narcotic and anesthetic.

There is an increase in blood-pressure, a sense of exhilaration, a ringing in the ears, followed by complete unconsciousness. Anesthesia is probably due to the displacement of oxygen in the blood and to direct action of the gas on the cerebrum.

**Describe the preparation of nitrous oxide gas.**

Nitrous oxide gas is prepared by heating ammonium nitrate, the vapor of which is passed through three wash-bottles containing, respectively, pure water, solution of caustic potash, and solution of ferrous sulphate.

**State the dose, toxic effect, and antidote of arsenic, aconite and morphia.**

*Arsenic*, dose  $\frac{1}{60}$  to  $\frac{1}{10}$  gr.

Toxic effects are: faintness, nausea, epigastric tenderness, profuse diarrhœa, skin cold, pulse small and feeble. The antidote is freshly-prepared ferric hydrate.

*Aconite* (Tincture) dose is  $\frac{1}{2}$  to 5 drops.

(Solid extract) dose is  $\frac{1}{4}$  gr.

Toxic effects.—Tingling sensation in the mouth, vomiting later, skin cold and clammy, pupils dilated, pulse small, weak and irregular, muscular weakness, death from asphyxia.

Antidote. — Emetics, artificial respiration, keep patient warm, stimulate with brandy, ether, digitalis, atropine.

*Morphia*, dose  $\frac{1}{8}$  to  $\frac{1}{4}$  gr.

Toxic effects.—Pulse becomes slower, respiration is mark-



edly reduced, reflexes become abolished, death occurs from paralysis of the respiratory center, or carbonic acid accumulation in the blood.

Antidotes.—Emetics in large doses, tannic acid as chemical antidote, strong coffee in stomach and rectum.

**Give the advantage and disadvantage of ether, chloroform and nitrous oxide as general anesthetics.**

*Ether.* Advantages. — Administered with greater safety than chloroform on account of lessened tendency to cardiac failure.

Disadvantages.—Tendency to produce struggling, and irritation to mucous membrane. It is highly inflammable, has disagreeable odor and is eliminated slowly.

*Chloroform.* Advantages.—Not unpleasant odor, narcosis quickly accomplished without struggling, eliminated rapidly by the kidneys.

Disadvantages.—Must be administered with great care as to admixture of air, contra-indicated in heart affections.

*Nitrous oxide.* Advantages.—Pleasant to take, can be administered in sitting posture, nausea seldom occurs, dangers almost nil.

Disadvantages.—Short duration of anesthesia, necessitating rapid operating.

**What is the physiological action and therapeutic use of arsenic?**

Physiological action.—Powerful caustic to all raw surfaces, gastro-intestinal stimulant in small doses; lessens the force and frequency of the heart's action; has great value in the treatment of chronic skin-diseases. Its dental use is for devitalization of the tooth-pulp.

**Describe the administration of nitrous oxide gas with precautions to be observed.**

Have patient remove all foreign substances from the mouth.

See that mouth-prop is securely fastened with cord. Avoid administration to patients under the influence of alcohol or opiates. Use an inhaler which permits of the administration of air with the gas.

**What is the first manifestation of danger in ether anesthesia?**

Sudden cyanosis, respiratory failure, weak, rapid pulse.

**Name two drugs useful in failure of respiration under anesthesia. State properties, dose and how administered.**

Atropine,  $\frac{1}{100}$  grain. It increases rapidity and depth of respiration by stimulating the respiratory center.

Strychnine, dose  $\frac{1}{60}$  to  $\frac{1}{20}$  grain, hypodermically. It also stimulates respiratory center.

**Give method of administering ether and treatment in case of collapse.**

*Open Method.* Ether vapor given with large admixture of air.

*Closed Method.* After first few respirations, ether vapor is given almost pure, only occasionally giving a breath of air. When full narcosis has been established, both methods are used alternately. In case of collapse, lower the head and raise the body, use artificial respiration, use inhalations of ammonia and amyl-nitrite, and injection, hypodermically, of strychnine, nitro-glycerin or digitalis.

**What are the advantages and disadvantages of local as compared with general anesthesia for extraction of teeth?**

Advantages in local anesthesia: less preparation of patient necessary, less time consumed, recovery immediate, no dread of unconsciousness, almost unlimited time for operation.

Disadvantages are pain upon the insertion of a needle, possibility of only partial anesthesia, and infection.

**Name three drugs or preparations useful in treating or**

**protecting recently exposed pulps before filling the cavities.**

Oil of cloves, campho-phenique, solution of menthol in chloroform.

**Describe the methods of administering cocaine to produce anesthesia.**

Topical and hypodermatical.

In topical application, cotton is saturated with a 10% solution of the drug, placed over the part and allowed to remain until sensation disappears.

In hypodermatic use a 1% to 5% solution of the drug is injected into the part at various points.

**Is general or local anesthesia the more suitable in operations about the mouth? Explain.**

Local anesthesia is preferable in operations about the mouth because of the free field of operation, unobstructed by the presence of apparatus used in general anesthesia.

**What remedies are useful for relief of toothache caused by near approach of caries to the pulp?**

Bicarbonate of soda in paste with glycerine, cocaine hydrochlorate, essential oils.

# PHYSICS, CHEMISTRY AND METALLURGY.

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## **What is meant by specific gravity?**

Specific gravity, or relative weight denotes the weight of a substance as compared with the weight of an equal bulk, or equal volume, of another substance, which is taken as a unit or standard.

## **Describe a hydrometer.**

A hydrometer is a cylindrical glass vessel weighted at the bottom, terminating above in a thin glass stem, which is divided into equal spaces called degrees, and the degrees are usually numbered from 1000 at the top of the stem increasing downward toward the center of the instrument. It is employed to determine the specific gravity of liquids.

## **What is water of crystallization?**

Water of crystallization is such water, in solid form, as gives to a substance its crystalline shape and, frequently, its color. It is not in chemical union with the substance, and leaves when substance is heated to  $212^{\circ}$  F.

## **What is the difference between deliquescence and efflorescence? Give examples of each.**

Some solid substances have the power of absorbing moisture from the air and are called deliquescent; such bodies may even be entirely liquified on exposure to air. The property certain crystallized substances have of losing water of crystallization when exposed to the air is known as efflorescence; such bodies lose their crystalline outlines and become

powdery. Calcium chloride and gold chloride show deliquescence. Common alum and ferrous sulphate are efflorescent.

**What is meant by the specific heat of a metal?**

The specific heat of a metal refers to the ratio between the quantity of heat a given weight of water contains, when both metal and water have the same temperature. It is often determined by observing the weight of ice melted by both the metal, and the same weight of water enclosed in a thin glass flask, when both, after being heated to the same temperature, cool to the same degree, in dried cavities in ice.

**Describe effervescence, hydrate, anhydride.**

Effervescence refers to the escape of a gas through a liquid, producing bubbling. A hydrate is a combination of a metal with a radical of the water type, as  $\text{KHO}$ . An anhydride is an oxide of an elementary substance, usually non-metallic, which will unite chemically with water to form an acid.

**Define elasticity.**

Elasticity is that property by virtue of which substances resume their former size and shape when they are relieved from the action of force upon them.

**Define separately the terms ductility, malleability and volatility, and give examples of each.**

Ductility is that property of matter by virtue of which it may be drawn into wire, e. g. gold, silver, platinum.

Malleability is that property of matter by virtue of which it may be hammered or rolled out into sheets, e. g. gold, copper, tin.

Volatility refers to the readiness with which substances pass into vapor, with or without heat, e. g. mercury, zinc, tin, iodine.

**Define anhydrous, alkaline, neutral.**

Anhydrous means deprived of water, as, anhydrous sulphate of copper.

Alkaline refers to the property a substance has which,



when in solution, turns red litmus-paper blue, unites with and neutralizes acids, forming salts; emulsifies fats, making soap, and possesses harsh acrid taste.

Neutral refers to that condition in which a substance showing neither acid nor alkaline properties, does not affect litmus in color.

**Define tenacity.**

Tenacity refers to the strength or resistance substances show to mechanical force seeking to pull their molecules apart. The tenacity of a metal expresses its resistance to fracture from a tensile or stretching force.

**What is meant by spectrum analysis.**

Spectrum analysis is a method for recognizing the presence of different substances owing to characteristic optical effects produced when such substances are viewed through a prism. The substance examined, if a metal, is usually heated to incandescence, when the light it yields passing through a prism gives rise to characteristic bands or lines of color leading to its recognition.

**Describe the construction of two galvanic cells and mention the chemicals used in each cell.**

Grove cell: Hard rubber cup filled with dilute  $\text{H}_2\text{SO}_4$ , containing "U" shaped strip of zinc. Immersed in this cup is a porous cup filled with strong nitric acid and a sheet of platinum.

Grenet cell: This has two plates of carbon between which a plate of zinc may be raised out of, or lowered into the liquid, which latter consists of a mixture of sulphuric acid, potassium bichromate and water.

**What is meant by potential as applied to electric bodies?**

Potential represents the difference in positive and negative conditions of a body, when its former condition of electrical equilibrium is disturbed by mechanical friction, as in rubbing glass, or molecular friction, as by chemical action.

It represents a stored force, and is present before the wires are connected. It is to electricity what temperature is to heat, and is practically identical with tension and with electro-motive force.

**Describe in detail the process of electro-plating.**

This term is usually applied to process of depositing a film of silver on surfaces of articles made of German silver, brass, etc.

The article to be plated is cleansed by immersing it in hot solution of caustic potash, and afterwards (often) in acid, and is well rubbed with a scratch brush.

It is then dipped in a solution of mercuric nitrate, rinsed in water, and at once suspended by thin copper wire in the plating trough, which contains a solution of silver cyanide with an excess of potassium cyanide, and is connected then with the negative pole of a battery.

From the positive pole of the battery a strip of pure silver is suspended in the liquid near to the article to be plated.

A current is now passed through the arrangement when the silver solution is decomposed and silver is deposited upon the article, while the pure silver strip slowly dissolves, forming cyanide of silver in the solution, thus restoring the strength in metal that the plating solution is losing.

**Describe the apparatus for generating electric currents from chemical action. State the chemical action involved in the process.**

A sheet of copper and a sheet of zinc placed in dilute sulphuric acid will generate an electric current because the zinc will be acted upon chemically by the acid more than the copper. A solution of sulphate of zinc will form in the acid, and hydrogen gas will be liberated to settle in bubbles on the copper sheet.

**Explain the structure and luminosity of a candle flame.**

The flame of a candle presents three well marked zones, or portion, best shown by lowering wire gauze upon the flame.

Viewed in such fashion we find the innermost zone to be colorless, of low temperature and composed of the vapors arising from the heating of the wax of the candle.

The second zone has the highest temperature, and is the luminous portion of the flame, and is occasioned by the burning or oxidation of the vapors of the inner zone, and owes its luminosity to particles of solid carbon heated to incandescence from the active chemical changes of oxidation.

The outer zone has a low temperature, and is composed of water vapor, carbon-dioxide and amorphous carbon, as the final result of burning of the wax of the candle. It is dark in color.

**Describe the Bunsen burner and give the chemistry of its flame.**

The Bunsen burner consists of a tube for the burning of gas, at the bottom of which are apertures for the admission of air. The air so dilutes the gas that all of the carbon of the gas undergoes combustion; carbon-dioxide and water result from burning.

It presents two well marked zones of flame and a third surrounding very indistinct film.

The inner flame is blue, pointed, of lower temperature and is known as the reducing flame, and its employment removes oxygen from bodies heated in it.

The second flame is colorless, surrounds the inner flame, is of highest temperature, represents perfect combustion, is known as the oxidizing flame because metal heated in it readily combines with oxygen of the surrounding air.

The film of practically invisible vapor surrounding these two flames is composed of water vapor and carbon-dioxide and has low temperature.

**Define cohesion, adhesion, gravitation. Mention instances in the action of each.**

Cohesion is an attractive force binding together molecules of like kinds and acts in the interior of bodies. Examples:

cohesion combines the molecules of water into visible drops, unites the molecules of silica to form grains of sand, holds together molecules of gold to produce gold leaves.

Adhesion is an attractive force binding molecules of unlike kinds together acting upon surfaces of bodies. Examples: water adheres to wood, glue to paper, alcohol to iodine. Both cohesion and adhesion require for their action that the substances be practically in contact. Adhesion also unites masses.

Gravitation is the attractive force which draws masses towards each other, acting when bodies are widely separated, as well as when in contact: Example, gravitation tends to keep the celestial bodies in their relative positions from the sun, occasions the fall of the apple from the tree to the earth, causes movement of the atmosphere.

**Describe the spectroscope and explain its use in a chemical analysis.**

A spectroscope consists of a tripod upon which is an optical prism and focused upon this latter are three telescopes, one of which is movable. A substance of unknown composition may be heated to incandescence before the distal end of one of the fixed telescopes and the light to which it gives rise enters through a narrow slit with parallel edges and passes through the prism. Here it is decomposed and the observer looking through the distal end of the movable telescope notes the effect of its decomposition of light from the object.

The other immovable telescope is provided with a micrometer scale which is reflected upon the prism by the light given by a burning candle placed at its distal end.

This reflected scale allows the observer to locate any characteristic bands or lines of color or darkness that the light from the incandescent substance produces when passing through the prism.

Thus, suppose a salt of unknown character to be heated to incandescence and when viewed by the observer through the movable telescope showed a field of blackness crossed vertically by a bright yellow line at a point in the scale marked

“D,” this would serve to recognize the substance as a salt of sodium, or the metal itself.

**Mention some conductors and some non-conductors of electricity, and explain their behavior in connection with the electric phenomena.**

Good conductors of electricity; silver, copper and gold.

Good non-conductors; glass, silk, rubber.

A good conductor offers little resistance to the passage of electricity over its surface.

A non-conductor offers great resistance or impedance to electric flow.

A conductor only remains electrified when surrounded by non-conducting, or insulating, material.

Non-conductors, when electrified as by friction, retain their electrical charge for a considerable time, but although a conductor may be electrified it instantly loses such charge.

**Describe destructive distillation and describe the gases generally formed during that process.**

Destructive distillation is the resolution of a complex substance into simpler forms under the influence of heat, out of contact with air.

Soft coal if heated in earthenware retorts connected with cooled receivers, so as to exclude air, would undergo destructive distillation, giving rise to gases and vapors including hydrogen, marsh gas, carbon monoxide, carbon dioxide, olefiant gas, nitrogen, etc.

**Define matter, force, energy.**

Matter includes all which the senses appreciate as having weight and occupying space.

Force is that which produces motion, or tends to produce motion, or resists change.

Energy is the capacity of any agent to do work.

**Distinguish the characteristics of matter in (a) the solid state, (b) the liquid state, (c) the gaseous state.**

(a) The solid state exhibits an independent form with



cohesion strongly marked between the molecules, yet varying in degree so as to give rise to properties of hardness, ductility, malleability, tenacity, etc.

Their shapes are often irregular; they do not unite after the passage through them of a cutting implement. They vary in elasticity.

(b) In liquid state cohesive force is less marked although present. Liquids have no independent form, they unite after passage of a cutting implement, they present horizontal surfaces, the particles move or flow freely over each other, they are perfectly elastic.

(c) In gaseous state no independent form is present, cohesion is absent, they unite after passage of cutting implement, their particles tend to spread from each other, they exhibit tension or pressure, are perfectly elastic and uniformly compressible and expand equally when heated no matter what their composition.

**What is (a) a permanent magnet, (b) an electro-magnet? State how each may be made.**

(a) A permanent magnet is one made of steel which once magnetized retains its magnetic properties indefinitely.

It may be made from a steel bar by rubbing the bar with an existing magnet in various ways.

(b) An electro-magnet is one that quickly parts with its magnetic properties, and as quickly regains them.

It consists of a bar of soft iron enclosed in a coil of insulated wire, and when an electric current passes through this coil the soft-iron bar becomes a magnet, but ceases to act as a magnet when the current of electricity no longer traverses the coil of insulated wire.

**What physical forces have a tendency to decompose compound substances? Give examples.**

Heat; as in the decomposition of mercuric oxide into mercury and oxygen.

Light; as in decomposition of silver chloride into subchloride of silver and chlorine gas.

Electricity; as in the decomposition of water into hydrogen and oxygen gases.

**Differentiate sensible heat, latent heat, specific heat.**

Sensible heat is that appreciated by the senses and indicated by the thermometer and is a measure of the intensity of heat.

Latent heat is not appreciated by sense of touch or the thermometer, but is the heat a body requires to affect its change, if solid into a liquid, or if liquid, into a gas or vapor.

Specific heat is the amount of heat a body contains compared with the heat an equal weight of water contains, when the body in question and water are at the same temperature.

**Define capillary attraction, absorption, diffusion, osmose.**

Capillary attraction is a modified form of adhesion, by virtue of which liquids ascend in small tubes to which they adhere, or descend in tubes that they cannot wet.

Absorption refers to the including of a substance, usually liquid or gaseous, into another substance, usually solid or liquid, without material increase in size of the absorbing body; thus charcoal absorbs ammonia gas, water absorbs oxygen, etc.

Absorption also refers, in optical phenomena, to the receiving of light by a body but its failure to reflect or transmit such light or colors. Thus we speak of absorption spectra.

Diffusion, if of liquids, is the gradual mixing of two liquids of different specific gravities when they are carefully placed, without mixing, in the same vessel, with the lightest liquid uppermost.

Diffusion of gases refers to the intermingling or mixing of different gases.

Osmose refers to the mixing of different liquids when separated from each other by porous partitions.

**Define anode, cathode, circuit, electric current, inductive force, electro-motive force.**

Anode is the name applied to the end of a positive wire or pole leading from a battery.

Cathode is the terminal of a negative wire or pole from a battery.

Circuit is the pathway the electric energy is said to traverse from battery out along conduction material back into the battery.

Electric current is the term applied to best describe the flow of electric energy from its source along its circuit.

Inductive force is shown by the power of an insulated, charged conductor to act on nearby unelectrified bodies, as a magnet acts on soft iron. It decomposes their neutral electric fluid into positive and negative constituents, attracting to itself the unlike and repelling the like electric fluid.

Electro-motive force is the force that sets electricity in motion causing the current to leave the cell or dynamo. It is the result of the tendency to re-establish equilibrium between quantities of positive and negative electricity after such equilibrium has been disturbed.

**State the uses of electricity in generating heat, light, and mechanical motion, and in favoring chemical action.**

Heat generated by electricity may be employed in porcelain furnaces for baking—may be used to reduce metal ores to metals, as in obtaining aluminum—may be used to melt refractory metals like platinum—to soften surface-hardened metals at certain points—to weld metals—for cooking and heating purposes, etc.

Light obtained by electric action may be of great intensity and may be applied to examination of cavities of the body, as in the use of the endoscope, etc.

Mechanical motion may be brought about by the action of an electric motor whereby motion is transmitted to various instruments such as the dental engines, lathe, etc.

By electric force we may bring about the union of many simple bodies to form complex or compound ones; as hydrogen and chlorine may be caused to unite by an electric spark; or we may obtain the separation of substances formerly

united, as by the electrolysis of gold chloride solution, yielding chlorine gas and gold.

**Describe a method by which electricity produces (a) heat, (b) light, (c) mechanical energy. Show that electricity favors chemical action.**

(a) Pass a strong current along a poor conducting metallic wire, as platinum, bent in a loop, and from the impedance or resistance the current encounters, the metal is heated, forming an instrument for cauterizing.

(b) Enclose a film of carbon in an exhausted glass globe and, in the absence of air, the carbon glows from incandescence due to the heat arising from resistance to the passage of the current.

(c) Pass the electric current through a coil of insulated wire that surrounds the bar of soft iron and the bar becoming magnetic draws to it an elastic hammer which it releases, to spring back and strike a bell, when the current ceases to flow through the coil of wire.

Pass an electric spark into a mixture of hydrogen and oxygen gases; they combine with explosive violence to form water vapor.

**Describe a method of obtaining the specific gravity of (a) solids, (b) liquids, (c) gases.**

(a) To obtain specific gravity of solids divide the weight of the solid in air by the weight it loses when suspended and weighed in water.

(b) To obtain specific gravity of liquids: Counterbalance an empty flask, then fill the flask with distilled water at  $60^{\circ}$  F., and find the weight of water the flask holds; empty the flask and fill it with the liquid to be examined at  $60^{\circ}$  F. and find the weight of the liquid the flask holds; divide the weight of the liquid by the weight of water, the result being the specific gravity of the liquid.

(c) To obtain specific gravity of gases exhaust a large glass flask of air and counterbalance; fill the flask with dry air at

0° C., and at a pressure of 760 mm. as shown by the barometer, and find how much this bulk of air weighs—then exhaust the flask of air and fill with the gas to be examined at the same temperature and pressure and weight—divide the weight of the gas by the weight of the air: the result will be the specific gravity.

**Mention four compounds, giving the formula and molecular weight of each.**

Water,  $\text{H}_2\text{O}$ , molecular weight 18.

Carbon dioxide,  $\text{CO}_2$ , molecular weight 44.

Sulphuric acid,  $\text{H}_2\text{SO}_4$ , molecular weight 98.

Nitric acid,  $\text{HNO}_3$ , molecular weight 63.

**Give the formula of carbolie acid. Mention an antidote.**

Carbolie acid,  $\text{C}_6\text{H}_5\text{OH}$ .

Antidote, a soluble sulphate, as Epsom salt.

**Place the chemical formula after each of the following acids: Sulphuric, nitric, hydrochloric.**

Sulphuric acid,  $\text{H}_2\text{SO}_4$ .

Nitric acid,  $\text{HNO}_3$ .

Hydrochloric acid,  $\text{HCl}$ .

**Give the formula of acetic acid, oxalic acid.**

Acetic acid,  $\text{HC}_2\text{H}_3\text{O}_2$ ; Oxalic acid,  $\text{H}_2\text{C}_2\text{O}_4$ .

**Give the common names of  $\text{H}_2\text{O}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{CO}_3$ , and  $\text{N}_2\text{O}$ .**

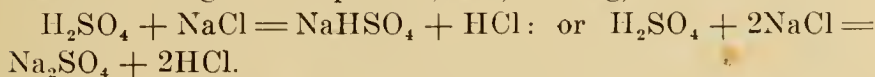
$\text{H}_2\text{O}$ , water;  $\text{HNO}_3$ , nitric acid or aqua fortis;  $\text{H}_2\text{CO}_3$ , carbonic acid;  $\text{N}_2\text{O}$ , nitrous oxide or laughing gas.

**Write the equation showing the reaction of sulphuric acid on common salt. State a general theory to this particular reaction.**

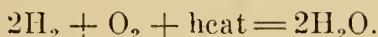
If two chemical compounds be brought in contact with each other under favorable conditions, should one or more elements of one of the compounds have an attraction or affinity for one



or more elements of the other compound, these elements will leave their original compounds, and, uniting, form new bodies.



**Give the chemical equation for the formation of water from its elements.**



**Give the formula and properties of (a) hydrochloric acid, (b) sulphuric acid, (c) sulphurous acid, (d) phosphoric acid.**

(a) Hydrochloric acid ( $\text{HCl}$ ) is a colorless gas, has a sharp penetrating odor, and is very irritating when inhaled. It is neither combustible nor a supporter of combustion, and has great solubility in water. Although hydrochloric acid is a gas this name is also employed for its solution in water. The hydrochloric acid of the U. S. P. is an acid containing 31.9% of  $\text{HCl}$ , and is a colorless, fuming liquid.

(b) Sulphuric acid ( $\text{H}_2\text{SO}_4$ ). Pure acid has a specific gravity of 1.848; it is a colorless liquid, of oily consistency, and has a great tendency to combine with water, absorbing it readily from atmospheric air. Upon mixing sulphuric acid and water, heat is generated. It also has the property of destroying and blackening organic matter, and is corrosive and caustic. The sulphuric acid of the U. S. P. should contain not less than 92.5% of  $\text{H}_2\text{SO}_4$ .

(c) Sulphurous acid ( $\text{H}_2\text{SO}_3$ ) is a colorless acid liquid which has the odor as well as the disinfecting and bleaching properties of dioxide of sulphur; it is completely volatilized by heat. The acid is easily oxidized by air to form sulphuric acid.

(d) Phosphoric acid ( $\text{H}_3\text{PO}_4$ ) is a colorless, odorless, strongly acid liquid, which on heating loses water, and finally is volatilized at a low red heat.

**Place the chemical formula after each of the following compounds: Hydrogen sulphide, potassium iodide,**

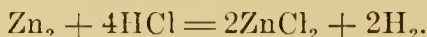
calcium sulphite, magnesium carbonate, and mercuric chloride.

Hydrogen sulphide,  $\text{H}_2\text{S}$ ; potassium iodide,  $\text{KI}$ ; calcium sulphite,  $\text{CaSO}_3$ ; magnesium carbonate,  $\text{MgCO}_3$ ; mercuric chloride,  $\text{HgCl}_2$ .

Place after each of the following compounds its chemical formula: Silver chloride, zinc sulphate, calcium oxide.

Silver chloride  $\text{AgCl}$ , zinc sulphate  $\text{ZnSO}_4$ , calcium oxide  $\text{CaO}$ .

Indicate by an equation the reaction of zinc with hydrochloric acid.



What chemical changes result from the addition of hydrochloric acid to silver nitrate? Answer by giving the equation.



Write the chemical formulae for sodium chloride, ferrous sulphate.

Sodium Chloride  $\text{NaCl}$ , ferrous sulphate  $\text{FeSO}_4$ .

Complete the following equations:  $\text{CuO} + \text{H}_2\text{SO}_4$ ;  $\text{Zn} + 2\text{HCl}$ ;  $\text{AgNO}_3 + \text{NaCl}$ .



Write the formula for ammonium hydrate and potassium nitrate.

Ammonium hydrate  $\text{NH}_4\text{OH}$ , potassium nitrate  $\text{KNO}_3$ .

Give common names for zinc sulphate, copper sulphate, aluminum oxide.

Zinc sulphate—white vitriol.

Copper sulphate—blue stone, or blue vitriol.

Aluminum oxide—alumina or corundum.

**What is understood by  $\text{H}_2\text{SO}_4$ ?**

Twice the atomic weight of hydrogen in chemical combination with once the atomic weight of sulphur in chemical combination with four times the atomic weight of oxygen, forming one molecule of sulphuric acid, representing 98 parts by weight of sulphuric acid.

**What does  $\text{H}_2\text{O}_2$  represent?**

One molecule or 34 parts by weight of pure hydrogen peroxide.

**Mention three acids used in medicine. Give the formula for each.**

Acetic acid,  $\text{HC}_2\text{H}_3\text{O}_2$ .

Sulphuric acid,  $\text{H}_2\text{SO}_4$ .

Hydrochloric acid,  $\text{HCl}$ .

**State the law of Avogadro and explain its relation to modern chemistry.**

Law of Avogadro: Under like conditions of temperature and pressure, equal volumes of all gases contain the same number of molecules.

By this law we find gaseous molecules of all kinds to be equal in size so that by weighing equal volumes of a gas and of hydrogen, when subjected to the same temperature and pressure, we can at once establish the molecular weight, and after analysis, deduce the molecular formula of the gas examined, and in the case of elementary gases determine the atomic weights.

**Differentiate between oxidizing agents and reducing agents.**

An oxidizing agent is a substance that readily parts with some or all of the oxygen it contains, giving it up to combine with other substances—this action occurring in most instances, under the influence of heat. Thus potassium nitrate if heated with lead, copper, etc., yields oxygen to those metals forming metallic oxides and itself changing to potassium nitrite.

Potassium chlorate and manganese dioxide are frequently used as oxidizing agents.

A reducing agent is a substance tending to combine with oxygen, so that it removes oxygen from other bodies: Thus when a mixture of charcoal and oxide of lead are heated, the lead oxide is reduced to form metallic lead, the carbon taking the oxygen from lead oxide becomes carbon dioxide. Hydrogen passed over cupric oxide or ferric oxide when heated, acts as a reducing agent.

**Explain the chemical terms monad, diad, triad, etc. Give an example of each.**

A monad, if an element, would unite with hydrogen in the proportion of once its atomic or combining weight with once the atomic weight of hydrogen; or, the monad if vaporized, would unite in equal measured volume with hydrogen.

Theoretically we state one atom of a monad combines with one atom of hydrogen.

If the monad be a compound radical, like  $\text{OII}$ , then the sum of the atomic weights of its constituents unite with once the atomic weight of hydrogen.

If the monad be a metallic element, or an electro-positive compound radical, its valency is shown by its power of displacing its own volume of hydrogen from compounds, or its combining weight will displace the combining weight of hydrogen from compounds; or, we often fix its valency by its combining with one equivalent of chlorine weighing 35.5.

A diad atom or radical combines with, or takes the place of two hydrogen atoms.

A triad combines with, or takes the place of three hydrogen atoms.

Among monads we have hydrogen, chlorine, potassium.

Among diads we have oxygen, sulphur, calcium.

Among triads we find nitrogen, boron, gold.

**Name two or more elements which ignite on contact with water.**

Sodium, potassium.

**What are the principal differences between metallic and non-metallic elements?**

A metallic element is solid at ordinary temperatures, with few exceptions. It has considerable weight, and is more or less malleable, ductile, and tenacious. It is opaque to light and is a good conductor of heat and electricity. It has luster, is electro-positive and forms at least one base with oxygen. It displaces hydrogen from acids to form salts. Substances not possessing these characteristics are grouped as non-metals.

**By what principle do elements combine to form compounds?**

In obedience to the laws governing chemical affinity; those atoms or radicals in unlike electrical conditions uniting to form compounds.

**Give examples of analysis and synthesis.**

Heating mercuric oxide produces the metal mercury and the gas oxygen (analysis).

Passing an electric spark through a mixture of equal volumes of hydrogen and chlorine produces hydrochloric acid (synthesis).

Passing a galvanic current through water we have produced one volume of oxygen and two volumes of hydrogen (analysis).

Heating one volume of oxygen and two volumes of hydrogen they unite with explosion to form water (synthesis).

**Why are the salts of some metals called sulphides, sulphites, and sulphates?**

Sulphides are binary compounds, one of the two elements present being sulphur. Sulphates and sulphites are ternary compounds, known as oxy-salts, containing sulphur, oxygen and a metal; the sulphates contain a larger number of oxygen atoms in each molecule than the sulphites.

**What are the essential properties of an acid?**

(a) It always contains hydrogen, which is wholly or partially replaceable by metals to form salts.



(b) It changes the color of many organic substances, litmus changing from blue to red.

(c) It has (when soluble in water) an acid or sour taste.

(d) It unites with and neutralizes a base to form a salt and water.

(e) It corrodes tissues when concentrated.

**By what force do atoms unite to form compounds? Give an example.**

By the force of chemical affinity favored by the action of one or more physical forces.

Example,  $\text{H}_2 + \text{Cl}_2 + \text{electric spark} = 2\text{HCl}$ .

**What is a chemical equation?**

It is a writing, or diagram, representing upon one side of an equality sign the formulæ of substances separated by plus signs, that when in contact, exert chemical action upon each other, leading to their decomposition, and upon the other side of the equality sign are placed the formulæ of the new bodies, separated from each other by plus signs, that result from this chemical action.

**How is molecular weight obtained? Give illustrations.**

Molecular weight is obtained by ascertaining the sum of the atomic weights, or multiples of the atomic weights, of the constituents of the molecules; or, by taking twice the density of a compound compared with hydrogen when both are in a gaseous state.

Molecular weight of  $\text{H}_2\text{O} = 2 + 16$  or 18.

Vapor density of  $\text{H}_2\text{O} = 9$ , then  $9 \times 2 = 18$ .

Molecular weight of  $\text{H}_2\text{SO}_4 = 2 + 32 + 64$  or 98; or, vapor density of  $\text{H}_2\text{SO}_4$  is 49, then  $49 \times 2 = 98$ .

**What is meant by chemical reaction?**

Chemical reaction represents by formula the re-arrangement of atoms and radicals after, through chemical action, they have been separated from their former union.

**What is the difference between two acids composed of the same elements, the name of the one ending in "ous" and that of the other in "ic"? Illustrate by giving name and formula.**

The acid that is most stable in composition, or of most importance, or is of greatest use, or from which salts of great importance are derived has its name terminating in "ic."

The acid whose name terminates in "ous" contains a less number of oxygen atoms in each molecule than the acid ending in "ic."

Examples, sulphuric acid  $\text{H}_2\text{SO}_4$ , nitric acid  $\text{HNO}_3$ .

Examples, sulphurous acid  $\text{H}_2\text{SO}_3$ , nitrous acid  $\text{HNO}_2$ .

**Distinguish between an element and a compound. Give an example of each.**

An element is a substance, the molecules composing which, contain the same kind of atoms; for example, copper, gold.

A compound is a substance, the molecules composing it being formed of different kinds of atoms, e. g. water, alcohol. Upon an element no force exerted will produce any other kind of matter than that originally present.

A compound may, by the exertion of certain forces, be decomposed, yielding different kinds of matter than the original substance.

**Describe the chemical process by which minerals are converted into animal foods.**

Mineral substances in the soil are dissolved in water, which often contains carbon dioxide or alkaline silicates, thus converting such mineral substances into soluble alkaline, or double salts. The rootlets of plants absorb such mineral material when in solution, and store it up in the plant, after the mineral substance undergoes chemical change into organic salts, as tartrates, citrates, acetates, etc., of the metal originally present in the mineral. The animal eating such plants then appropriates these organic salts after effecting

their change, in the animal body, into such salts as carbonates, phosphates, sulphates, etc.

**Give an example of (a) a physical change, (b) a chemical change, (c) a mixture, (d) a chemical compound.**

(a) The dissolving of salt in water, the melting of ice.

(b) Union of silver with nitric acid to form silver nitrate; union of oxygen and hydrogen to form water.

(c) Iron filings mixed with sulphur; sand mixed with sugar.

(d) Apply heat to iron filings when they unite chemically to form ferrous sulphide which exhibits different properties than either iron or sulphur when alone.

**Classify the following acids, bases or salts: (a) lime, (b) vinegar, (c) cream of tartar, (d) baking soda, (e) ammonia.**

<i>Acids</i>	<i>Bases</i>	<i>Salts</i>
Vinegar	Lime	Cream of tartar
	Ammonia	Baking soda

**Define negative elements, positive elements. Mention the conditions under which negative and positive elements act on each other. Illustrate this action.**

A negative element is one which if freed from a compound by electrolysis would be found at the positive electrode. A negative element is one that combines with oxygen to form an acidulous compound. A negative element is a metalloid.

A positive element is one which when freed from a compound by electrolysis appears at the negative electrode. A positive element is one that combines with oxygen to form a basic or neutral oxide. A positive element is a metal.

Negative and positive elements combine when in nascent or atomic conditions, when in contact, and when the exertion of a physical force favors the union.

**How is matter classified?**

Simple and compound. Mineral, animal and vegetable.

Organic, inorganic and organized.

Atom, molecule and mass.

Solid, liquid, gaseous, and radiant.

**In what condition are elements generally found in nature? Mention two exceptions.**

In combination with other elements forming compounds. Exceptions, carbon as diamond and oxygen mixed with nitrogen in atmospheric air; in these instances carbon and oxygen are in their elementary forms.

**Define atom, molecule.**

An atom is the smallest indivisible particle of elementary matter, not capable of self-existence but passing from one compound to another in chemical interchanges.

(New). An atom is an aggregation of a definite number of corpuscles or electric units, oscillating as a whole; upon the number and rapidity of movement of these corpuscles, the chemical identity of the atom depends.

A molecule is the smallest part of any substance that can exist alone and exhibit the properties of the substance. It is a cluster of two or more atoms bound together by chemical affinity.

**What is meant by analysis?**

Analysis is the name given to the process of separating elements from compounds or compounds from complex structures, leading to the recognition of elements or compounds that exist in more complex bodies. Analysis is the process of determining the composition of a body by separating its constituents.

**What is synthesis?**

Synthesis is the name given to the process of producing substances by bringing about the union of their constituent elements, or simpler compounds.

**For what element is there the most extensive affinity?**

Oxygen.

**State how to obtain an atomic weight.**

The atomic weight equals 6.4 divided by the specific heat of the element. We may also obtain the atomic weight by noting in what weight the element, if it be a monad, will replace one part by weight of hydrogen in an existing compound.

By obtaining its vapor density compared with hydrogen.

**Define electrolysis. Describe an experiment illustrating it.**

Electrolysis consists of the separation of the constituents of a compound through the action of an electric current. Iodine may be separated from potassium by passing an electric current through a solution of potassium iodide, when, if starch mucilage be present, the liberated iodine combines with it to form bluish-black iodide of starch.

**State the theory of valency.**

Valency expresses the numerical power for union by volume, which different elementary substances show, compared with one volume of hydrogen. Theoretically it indicates the number of hydrogen atoms required to unite with or to take the place of one atom of another element, or radical.

**Distinguish between alkali and alkaloid.**

An alkali is a soluble base.

It is an oxide or hydrate of an alkaline metal. It is a mineral substance whose solutions turn red litmus blue. It neutralizes acids to form salts and water. It forms soaps with fats. When strongly heated it leaves a residue.

An alkaloid is an active principle of an organic substance and is alkaline in reaction. It always contains nitrogen and, in addition, carbon, hydrogen and often oxygen. It is called an organic base. An alkaloid when heated burns with an odor of burning feathers, then forms a black char, and on continued heating entirely disappears.

**By what process are constituents of compounds obtained? Give an example.**

By electrolysis and by heat. Separation of oxygen and



hydrogen from water by electrolysis. Separation of oxygen and mercury from mercuric oxide by heat.

**Explain the use of atomic weights.**

Atomic weights are used as combining weights, giving us the proportion by weight of one element required to unite with a definite weight of a second element in forming a compound.

**Distinguish between a simple molecule and a compound molecule.**

A simple molecule is composed of atoms of the same kind. A mass of such molecules is known as an element.

A compound molecule is composed of atoms of different kinds. Such molecules in mass are spoken of as compounds.

**Mention two ways in which elements occur in nature, and give examples of three elements occurring in both these ways.**

In uncombined state, as oxygen mixed with, but not in combination with nitrogen in air; as nitrogen found elementary in air; as carbon found elementary in diamonds, in graphite.

In compounds or unions with other elements: As oxygen combined with metals occurring as oxides, as nitrogen found combined as salts called nitrates, in the soil; as carbon existing combined as carbonates united with different metals, as in limestone.

**Explain the use of symbols and formulae. Give and translate five examples of each.**

A symbol is used to represent one atom of an elementary substance.

A formula is a combination of symbols that represents one molecule of a substance.

Examples of symbols: Oxygen, O; hydrogen, H; sulphur, S; nitrogen, N; chlorine, Cl.

Examples of formulæ: Water,  $\text{H}_2\text{O}$ ; nitric acid,  $\text{HNO}_3$ ; sulphuric acid,  $\text{H}_2\text{SO}_4$ ; hydrochloric acid,  $\text{HCl}$ ; ozone,  $\text{O}_3$ .

**What is the difference between a mixture and a chemical compound?**

Mixtures are joined together by adhesion and cohesion, and can be separated by such physical means as heat, magnetism, solution, etc., and the constituents may be mixed in any proportion, and when mixed do not lose their characteristic properties nor give rise to heat. A chemical compound is one joined through chemical force, differs in properties from those of its constituents, forms only on combining definite weights of constituents, and its production is accompanied by heat.

**Mention a test by which organic compounds may be distinguished from inorganic compounds.**

On heating the substance, if it be organic, it first chars and then burns entirely away, leaving no residue; if it be inorganic, it does not char and although strongly heated leaves a residue, (except in the case of ammonia compounds, and water, which do not leave residues when heated).

**Define (a) monad, (b) diad; (c) give examples of each.**

(a) A monad is an element or compound radical whose atom or radical has the power of replacing one atom of hydrogen from a compound, or combining with one atom of hydrogen; examples; potassium, sodium, silver.

(b) A diad is a substance whose atom or radical has the power of replacing two hydrogen atoms from a compound, or requires two hydrogen atoms with which to combine; examples, oxygen, sulphur, calcium.

**Explain how it is that heat both oxidizes certain metals and de-oxidizes their oxides.**

Heat brings about the union of the oxygen of the air and certain base metals like copper, which when heated in air forms cupric oxide. An intense heat weakens chemical affinity, so that if a body desirous of combining with oxygen be heated with a metal oxide the oxygen leaves the metal to join

the other substance; thus, cupric oxide heated with charcoal produces the metal copper and carbon monoxide and carbon-dioxide.

Very high temperatures as exist in the sun prevent chemical union of elements.

Heat of low intensity may occasion combination with oxygen, as when barium monoxide changes to barium dioxide when heated in air; and on raising the temperature this new compound again produces barium monoxide and oxygen.

**State and illustrate the law of multiple proportions.**

If two elements, "A" and "B," enter into chemical combination with each other in more than one proportion the quantities of B which unite with a fixed quantity of A will bear a simple ratio to each other. Nitrogen and oxygen combine in five distinct proportions with each other: thus 28 parts by weight of nitrogen combines with 16, 32, 48, 64, and 80 parts by weight of oxygen. Representing nitrogen by A we then find that to every seven (7) parts by weight of nitrogen there will unite 4, 8, 12, 16, or 20 parts of oxygen, which we represent by B.

**Define potential as applied to electro-chemistry.**

It refers to the stored charge of either negative or positive electricity held by the ion at the moment of its dissociation.

**Define chemical affinity and state how it differs from other forces.**

Chemical affinity is the attractive force which acts between atoms of matter. In its action it differs from the molecular or physical forces in acting upon atoms, in being accompanied in its action by heat, in producing new substances as a result of its action, and in acting inside the molecules of matter.

Physical forces act outside the molecules.

Both chemical affinity and physical forces act at inappreciable distances.

Molar forces, like gravitation, etc., act upon masses and often when they are widely separated.

**Differentiate, from a chemical standpoint, animal life and vegetable life.**

Chemical changes that occur in plants are more those of synthesis, while in animals analytical changes predominate.

The plant takes as food simple substances or compounds, and constructs them into complex bodies.

The animal takes as food complex bodies yielded by plants and decomposes them into simpler bodies, transposing their potential energy into kinetic.

The products of vegetable chemical activity are frequently crystalline and may often be artificially produced.

The products of animal chemical activity are usually fibrous or cellular, and cannot be manufactured.

**Define a chemical compound. Mention three chemical compounds.**

A chemical compound is a substance whose molecules are composed of different kinds of atoms. Examples: Water  $\text{H}_2\text{O}$ , alcohol  $\text{C}_2\text{H}_5\text{OH}$ , ammonia  $\text{NH}_3$ .

**What is analytical chemistry? State the object of (a) qualitative analysis, (b) quantitative analysis. .**

It is that department of chemistry that has to do with the separation of compounds or complex structures into simpler ones, and the recognition and estimation of these simpler substances.

(a) Qualitative analysis seeks to ascertain the different kinds of elements composing compounds or compounds present in complex structures.

(b) Quantitative analysis seeks to determine the amount of elements present in a definite quantity of a compound or the amount of simple compounds existing in a given quantity of a complex structure.

**Differentiate organic chemistry and inorganic chemistry.**

Organic chemistry is the chemistry of the hydrocarbons and their derivatives. The number of elements in organic compounds is usually small; but the number of atoms in the molecule is frequently large.

Organic chemistry treats of substances composing vegetable and animal structures and the products of animals and plants.

Organic chemistry treats largely of compound radicals.

Inorganic chemistry is the chemistry of mineral substances: is largely a study of elementary matter and their combinations.

Number of atoms in a molecule is usually small.

**Mention four chief elements that enter into organic compounds.**

Carbon, hydrogen, oxygen, and nitrogen.

**State one of the reasons for regarding the atomic weight of oxygen as 16 instead of 8.**

Its density compared with hydrogen is 16, not 8.

**Explain the following terms: Slow combustion, combustible substances, supporter of combustion.**

Slow combustion refers to oxidation of a substance, the process extending over considerable time, and being unaccompanied by evolution of light and with scarcely perceptible increase of temperature.

A combustible substance is one which under proper conditions unites chemically with other bodies giving rise to heat and light.

A supporter of combustion is a substance, like oxygen, in which a combustible substance will burn, undergoing rapid oxidation.

**Give two methods of obtaining hydrogen.**

- (1) By the action of zinc on sulphuric acid.
- (2) By the electrolytic decomposition of water, and col-



lection of hydrogen in a tube placed over the negative electrode.

**Describe the preparation of hydrogen.**

Place zinc in dilute sulphuric acid and hydrogen gas will be evolved which may be collected in jars previously filled with water; while in the dilute acid, sulphate of zinc will be produced.

**(a) What is hydrogen? (b) State some of its chemical relations.**

Hydrogen is a colorless, odorless, tasteless gas, the lightest of the well-known elements, its symbol is H, atomic weight 1, valency 1, condition electro-positive.

It combines with all non-metals and with a few of the weaker metals like arsenicum and stibium.

**Give two methods for obtaining oxygen.**

The oxides of the noble metals are decomposed at a low temperature; so, heat red oxide of mercury, obtaining oxygen gas.

Potassium chlorate,  $\text{KClO}_3$  is decomposed by heat into potassium chloride,  $\text{KCl}$  and oxygen gas.

**Mention three methods for obtaining oxygen.**

(1) Heat barium peroxide above a red temperature when barium monoxide and oxygen gas are produced.

(2) Heat a mixture of potassium chlorate and manganese dioxide, when oxygen gas is evolved at a comparatively low temperature.

(3) Pass a galvanic current through water and collect oxygen gas in a tube placed over the positive electrode; such oxygen resulting from the decomposition of water.

**What is the compound of oxygen and another element called?**

An oxide.

**What is ozone? Name some of its properties.**

Ozone,  $O_3$ , is a blue, irritating, and irrespirable gas, heavier than air, readily soluble in ether, turpentine, etc.

It occurs naturally, in very minute quantity, in pure air, particularly near pine forests, the sea-shore, and where large films of water undergo rapid evaporation.

It oxidizes substances more energetically than oxygen, acting upon substances like silver, that resist the action of ordinary oxygen.

It bleaches, disinfects, and strongly oxidizes.

**How can it be determined that the composition of water is  $H_2O$ ?**

By passing an electric current through water, and by so decomposing it we obtain two volumes of hydrogen and one volume of oxygen weighing respectively 2 for hydrogen and 16 for oxygen. (Analysis).

By mixing two volumes of hydrogen, weighing, say 2 grains and one volume of oxygen, weighing, say, 16 grains, and passing an electric spark through the mixture, the result will form 18 grains or two measured volumes of water vapor. (Synthesis.)

**Distinguish between oxygen and ozone.**

Oxygen is a colorless gas, no difficulty is experienced in inhaling it, its molecule contains two atoms.

Ozone has a blue color, is so irritating when inhaled as to produce hemoptysis, when concentrated. Ozone is far more active in producing oxidation of substances than is oxygen; its molecule contains three atoms.

**What influence has temperature on a mixture of hydrogen and oxygen?**

A high temperature causes their chemical union to form vapor of water, such formation accompanied by explosive violence.

**How is hydrogen dioxide obtained and what is its formula?**

It is obtained by the decomposition of barium dioxide suspended in water on adding sulphuric acid,  $\text{BaO}_2 + \text{H}_2\text{SO}_4 = \text{BaSO}_4 + \text{H}_2\text{O}_2$ . The  $\text{H}_2\text{O}_2$  thus obtained is not pure, but contains a considerable quantity of water. From this aqueous solution we can obtain a 50% solution by evaporation at a temperature not exceeding  $140^\circ \text{F}$ . If this product is placed in vacuo over strong sulphuric acid, a nearly pure or 100% syrup-like hydrogen dioxide results.

**State the use of  $\text{H}_2\text{O}_2$ .**

It is used as a disinfecting, bleaching and oxidizing agent.

**What chemical change occurs in the action of  $\text{H}_2\text{O}_2$  as a germicide or antiseptic?**

$\text{H}_2\text{O}_2$ , in contact with organic matter, particularly pus, is decomposed into water and nascent oxygen. The oxygen so freed destroys germs or renders the soil non-fertile.

**Explain the reaction of  $\text{H}_2\text{O}_2$  on putrescent pulps.**

In contact with pus  $\text{H}_2\text{O}_2$  is decomposed into water and nascent oxygen and the oxygen then acts on morbid matter, oxidizing it into harmless substances.

**Name the elements of the chlorine group. Give brief and separate descriptions of their properties.**

Fluorine, chlorine, bromine, iodine.

Fluorine: A yellow gas, heavier than air, most active of all chemical elements, monad in valency, electro-negative, always existing combined as fluorides of metals, as calcium fluoride.

Acts chemically upon water forming hydrofluoric acid and ozone. Very corrosive, has bleaching and disinfecting properties, has marked affinity for hydrogen, silicon, etc. Does not combine chemically with oxygen.

Chlorine: A green gas readily liquified, two and a half times the weight of air, is monad in valency, electro-negative, combines with most elements, never found elementary, exists

universally in combination with sodium in mineral, animal and vegetable substances, is a strong bleaching agent, is disinfectant, and indirectly, through its affinity for hydrogen, acts as an oxidizing agent.

Unites with some of the metals with such vigor as to occasion true combustion, as with antimony, arsenic, etc.

Less active in its chemical combinations than fluorine, is soluble in water, exerting a slight decomposing effect upon water.

**Bromine:** A heavy red liquid, three times the weight of water, giving rise to orange-red fumes at all temperatures, is monad, electro-negative, less active chemically than F or Cl. It bleaches, disinfects and indirectly oxidizes. It forms no oxides. It is used as a caustic, combines with most metals and some of the non-metallic elements, its binary metallic salts are nervous depressors.

**Iodine:** Occurs as a blue-black, scale-like solid, five times the weight of water, volatile at all temperatures, color of vapor, violet, monad, electro-negative.

It possesses the properties of the other members of this group, although it is less active: is slightly soluble in water, more soluble in alcohol and freely so in ether and chloroform.

**Describe a method of preparing chlorine.**

Heat hydrochloric acid and manganese dioxide and collect the heavy chlorine gas that is evolved by downward displacement in empty jars.



**How is muriatic acid prepared? Give the equation.**

By roasting a mixture of sodium chloride and sulphuric acid and passing the resulting gas, HCl, into water.  $\text{NaCl} + \text{H}_2\text{SO}_4 = \text{NaHSO}_4 + \text{HCl}$ .

**Give the symbol and the method of preparation of iodine. State the use of iodine in dentistry.**

Iodine, I, is prepared from any iodide by the action of a mixture of manganese dioxide and sulphuric acid.



The tincture is a counter-irritant, astringent and antiseptic, in the latter office particularly useful in the last stages of putrefactive decomposition. In strong tincture, combined with tincture aconite, it is applied to the gums in chronic pericementitis as a counter-irritant. In diluted tincture it is applied as an antiseptic and astringent in cases of congestion of the gums and pyorrhea alveolaris. It is useful in removing green stain.

**State the three allotropic forms of carbon.**

Diamond, graphite, lampblack.

**Name some of the purer forms of carbon as found in nature.**

Diamond, graphite, and anthracite coal or fossil carbon, often containing as high as 92% of carbon.

**What per cent. of  $\text{CO}_2$  exists permanently in air? What per cent. of  $\text{CO}_2$  is dangerous to life?**

Four parts of  $\text{CO}_2$  exist permanently in 10,000 parts of air, or .04%. More than 6 parts of  $\text{CO}_2$  in 10,000 parts of air, if the  $\text{CO}_2$  is accompanied by respiratory impurities, is dangerous to life.

Air containing one-twelfth of its volume of pure  $\text{CO}_2$  will produce suffocation.

**Mention three great natural sources of  $\text{CO}_2$ .**

Respiration of animals, burning of carbonaceous matter, decomposition of carbonates by heat or chemical action, alcoholic fermentation.

**State the conditions in which carbon is found in nature.**

It is found elementary in graphite and diamond.

Is found combined in many gaseous forms, as  $\text{CO}$ ,  $\text{CO}_2$ ,  $\text{CH}_4$ ,  $\text{C}_2\text{H}_4$ , etc.; and exists combined in minerals as carbonates and bicarbonates. is found in the composition of all animal and vegetable structures and occurs in large deposits in the many kinds of coal.



**Give the physical and chemical properties of carbon in each of three modifications.**

Diamond, hardest of substances, crystallizing in modifications of regular octahedra, density 3.5, possesses the strongest of refracting power, disperses light, poor conductor of electricity and heat, its chemistry is that of almost pure carbon.

Graphite occurs imbedded in rocks in steel-gray foliated masses, sometimes in hexagonal tablets, can be scratched with the finger nail, makes black mark on paper, density 2.2., conducts heat and electricity.

Lampblack is a soft, amorphous powder obtained from the incomplete combustion of carbonaceous matter; it contains tarry matter, is impure and is used in making printer's ink and paint.

In chemical properties, each form of carbon is electro-negative, is indisposed to enter into chemical union directly, except with oxygen, sulphur and a few elements. Carbon has an atomic weight of 12, is diad and tetrad in valency and is a solid non-metallic element.

**How does  $N_2O$  rank as a supporter of combustion and of respiration?**

$N_2O$  supports combustion but not as well as pure oxygen. It supports combustion only through its decomposition by the heat of introduced articles, practically producing a mixture of two volumes of nitrogen and one of oxygen.

It does not support respiration of animals.

**Describe the manufacture of  $N_2O$ .**

$N_2O$  is obtained by heating ammonium nitrate, that has been fused, at a temperature between  $470^\circ$  F. and  $490^\circ$  F. The vapor so produced is then passed through three jars containing water, ferrous sulphate solution, and potassium hydrate solution; the gas is then liquified by pressure, in steel cylinders, in which form it is sold.

**How many nitrogen acids are there? State the name and formula of each.**

Nitric acid,  $\text{HNO}_3$ ; nitrous acid,  $\text{HNO}_2$ ; hypo-nitrous acid,  $\text{HNO}$  or possibly  $\text{H}_2\text{N}_2\text{O}_2$ .

**Describe ammonia and give its chemical formula.**

Ammonia,  $\text{NH}_3$ , is a colorless gas, each molecule of which is composed of once the atomic weight of nitrogen in chemical combination with three times the atomic weight of hydrogen.

It is the second lightest compound gas, has a pungent, irritating, irrespirable odor, burns feebly, has a strong acrid taste, is corrosive and is the strongest of basic substances called the volatile alkalis. It is very soluble in water forming with water a chemical compound known as ammonium hydrate. It combines with acids to form salts without displacing the hydrogen of the acids.

**Write the formula of ammonia. State how ammonia is formed in nature.**

Ammonia,  $\text{NH}_3$ . It is formed naturally as the result of decay of nitrogenous matter, of organic nature, in the presence of moisture, due to bacterial action, and is given off to the air in vaporous forms or is deposited in soils combined, as nitrates, nitrites or chlorides of ammonium.

**State the physical and chemical properties of nitrogen.**

Nitrogen, symbol N, atomic weight 14, valency 1, 3, 5. Is electro-negative, combines with but few elementary substances, is inert, but enters into the composition of many active bodies, as the alkaloids, the proteid foods, the volatile alkali, and explosives. It is capable of being liquified and solidified by cold and pressure, is without color, odor or taste, is slightly lighter than air, and is soluble in water to the extent of 2% by volume. It is neither combustible nor a supporter of combustion.

**Mention the principal constituents of atmospheric air**

and state the proportions in which these constituents are present.

	<i>Volume</i>	<i>Weight</i>
Oxygen .....	20.93	23
Nitrogen .....	79.07	77

Including about 1% of argon, water vapor .5 to 1%, carbon dioxide .04.

Traces of ammonia and nitric acid.

**Mention some decompositions by which ammonia is generated.**

By heating equal weights of quick lime and ammonium chloride, ammonia gas will be produced.

Ammonia gas is produced during the destructive distillation of soft coal in illuminating gas manufacture.

Ammonia gas forms during the putrefaction of nitrogenous organic matters.

**Describe a method by which the four chief constituents of atmospheric air may be determined.**

Pass a weighed quantity of air successively through tubes or bulbs containing: First tube, calcium chloride; second tube, solution of caustic potash; third tube, copper heated to redness; fourth tube, magnesium heated to redness.

Water vapor will be retained in the first tube, the increase in weight of which will indicate the amount of water vapor in the quantity of air employed.

Carbon dioxide will be retained in, and increase the weight of, the second tube.

The quantity of oxygen from the air employed will be denoted by the increase in weight of the third tube.

Nitrogen combining with magnesium will indicate by the increase in weight its quantity in the air examined.

**(a) Name and briefly describe the two principal elements of the atmosphere. (b) Are these elements free or in chemical combination.**

(a) Oxygen and nitrogen.

Oxygen: symbol O, atomic weight 16, specific gravity 1.1056, valency 2.

It is a colorless, odorless, tasteless gas, capable of being liquified and solidified by cold and pressure. It is soluble to the extent of 3% in water, is electro-negative, forms chemical union with all well-known elements but fluorine.

Exists in air, and is dissolved in water, in elementary form, and is found in chemical compounds of animal, vegetable and mineral kingdoms. Constitutes one-third of all matter of the earth, supports combustion and respiration, is not poisonous, but in concentrated form acts as a general stimulant; it presents one allotropic form known as ozone. May be obtained by strongly heating potassium chlorate.

Nitrogen: symbol N, atomic weight 14, specific gravity .971, valency 1-3-5.

It is a colorless, odorless, tasteless gas, capable of being liquified and solidified, less soluble in water than oxygen, is electro-negative and very inert chemically, but enters into the formation (in its atomic condition) of very active chemical substances, as ammonia, proteids, alkaloids, explosives, etc.

Number of elements with which it combines is limited.

Obtained by passing atmospheric air over copper heated to redness, which withdraws from the air its oxygen.

(b) These two elements exist free or elementary, only being mechanically mixed to form air.

**Mention three acids commonly employed in dentistry and give the specific use of each.**

Sulphuric acid—Local application to root canals, used for refining gold, for cleaning plates, as a solvent.

Nitric acid—Used for refining gold, dissolving metals, as an oxidizing agent.

Glacial phosphoric acid—Its solutions are added to zinc oxide in making oxy-phosphate of zinc cement.

**What is aqua regia and its principal property?**

Aqua regia is a mixture of water, nitrosyl chloride and

chlorine gas, obtained by adding one to two parts strong nitric acid to four to five parts strong hydrochloric acid.

It is a solvent for gold and platinum. It is also used medicinally.

**Mention four of the principal elements found in the human body.**

Oxygen, hydrogen, carbon and nitrogen.

**What proportion of the air is nitrogen?**

Nitrogen constitutes about four-fifths of atmospheric air.

**Name the constituent elements and properties of the atmosphere.**

Oxygen, nitrogen, argon, and a few recently discovered elements. The atmosphere has no color, odor, or taste; it is 14.4 times the weight of hydrogen; can be liquified and solidified by cold and pressure; it exerts a pressure at the sea level of 14.7 pounds per square inch; it readily supports combustion from the oxygen that it contains. It is a mechanical mixture, and as such its composition slightly varies.

**(a) Describe the chemical changes that occur in the process of bleaching. (b) Name two bleaching agents employed in dentistry.**

(a) Chlorine only bleaches in the presence of moisture, combining with the hydrogen of water to form HCl, and liberating nascent oxygen, which latter oxidizes and so destroys coloring matter.

Peroxide of hydrogen in watery solution.

(b) Chlorine, as in chlorine water or chlorinated lime.

Peroxide of hydrogen in contact with organic coloring matter is decomposed into water and nascent oxygen, and this latter destroys coloring matter.

**Describe the occurrence of sulphur in nature.**

Sulphur is found near volcanoes mixed with soil; it also occurs as crystalline deposits in rock. It is found naturally combined with most metals forming metallic sulphides, as of



lead, zinc, mercury, etc.; also occurs in metallic sulphates, as of calcium sulphate, barium, sodium, magnesium; it exists in water as alkaline sulphides, as sulphur dioxide and as sulphuric acid.

It is present in combination in many animal fluids and tissues, as albumin, hair, horn, etc. It exists in many vegetable substances, particularly such as yield oils of great pungency, as mustard and horseradish.

**Mention with regard to sulphur, (a) atomic weight, (b) valency, (c) color, (d) odor, (e) taste, (f) solubility, (g) behavior when treated.**

(a) 32; (b) 2, 4, 6; (c) lemon-yellow; (d) none (but its dioxide has a characteristic odor); (e) none; (f) insoluble in water, slightly soluble in hot alcohol and in chloroform, freely soluble in carbon disulphide and in alkaline solutions; (g) melts at  $115^{\circ}$  C. Becomes viscid at  $200^{\circ}$  C. to  $250^{\circ}$  C., when it adheres to vessel when inverted, again becomes thin and liquid above  $250^{\circ}$  C., boils at  $440^{\circ}$  C.

**What is blue vitriol? Describe the manufacture of blue vitriol and state its properties. Mention the uses in dentistry of blue vitriol.**

Blue vitriol is cupric sulphate  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ . It is manufactured by dissolving copper in sulphuric acid; is also obtained as a by-product in silver refining. It occurs as blue prismatic crystals, astringent, freely soluble in water.

In dentistry it is used, dissolved in ammonia, as an astringent and styptic. It is a source from which pure copper may be obtained. It is used in several forms of galvanic cells.

**Give the name and properties of  $\text{H}_2\text{SO}_4$ . Describe the manufacture of  $\text{H}_2\text{SO}_4$ .**

$\text{H}_2\text{SO}_4$  is sulphuric acid. It is a highly corrosive, strongly acid, heavy, oily-like liquid. It is known as one of the mineral acids. It combines with water producing great elevation of temperature. It dissolves many metals; its specific gravity is 1.8.

Sulphur or a sulphide is burned in air and the resulting  $\text{SO}_2$  gas, together with nitric acid gas and steam, passed into a series of leaden-lined chambers. These three vaporous substances combine to form sulphuric acid, which, first vaporous, liquifies and falls in a rain to the floor of the chamber: from this it is removed and concentrated by evaporation.

**What is  $\text{CaSO}_4$  and what are its uses in dentistry?**

$\text{CaSO}_4$ , containing water of constitution, is gypsum. On being roasted it parts with a portion of its water, forming plaster-of-paris. This latter substance is used for taking impressions or models of the interior of the mouth. Moulds of plaster are also used for the deposition, by electrolysis, of metal.

**How does plaster-of-paris differ chemically from quick-lime?**

Quick-lime is oxide of calcium,  $\text{CaO}$ .

Plaster-of-paris is dehydrated sulphate of calcium.  $3\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ . (Bloxham).

**Describe the simplest test for sodium and potassium salts in solution.**

Concentrate the solution, clean a platinum wire and wetting it in the solution, hold it in the inner Bunsen flame, when the outer flame will be colored yellow if sodium be present, and violet or pink if potassium be present. If both metals are present observe the yellow flame that sodium yields through blue glass, when the flame that potassium yields may be seen.

**Describe the preparation of plaster-of-paris. Explain the setting of plaster-of-paris.**

By roasting gypsum at temperatures between  $300^\circ \text{F}$  and  $400^\circ \text{F}$ ., it loses about two-thirds of its water of constitution, and is then powdered. In the setting of plaster the water with which it is mixed unites with the plaster-of-paris to give a substance containing slightly less water of constitution than gypsum before being roasted.

**Name the chemical constituents of saliva.**

Water .....	994.10	
Solids		
Ptyalin.....	1.41	
Epithelium and proteids (including serum, albumin, globulin, mucin, etc.) .....	2.13	
Fat .....	0.07	
Salts:		
Potassium Sulpho-Cyanate,	}	2.20
Sodium Phosphate,		
Calcium Phosphate,		
Magnesium Phosphate,		
Sodium Chloride,		
Potassium Chloride.		
		<hr/> 1000.

**State the salts that enter into the formation of human bone.**

Calcium phosphate, sodium chloride, magnesium phosphate, calcium fluoride, calcium carbonate.

**What is the difference between assay and analysis?**

An assay is a process for determining the proportion by weight of one or several substances in a complex body, as, for instance, the amount of silver in a silver ore, or the amount of morphine in a specimen of opium.

Analysis is used for determining the proportion by weight of all substances in a compound, whether metallic or non-metallic in character.

**Give an antidote for sugar of lead.**

Antidote for sugar of lead: A soluble sulphate, as sulphate of magnesium.

**Give the properties of phosphoric acid and describe the official process of making it.**

Ortho-phosphoric acid,  $\text{H}_3\text{PO}_4$ .

It is a colorless, odorless, strongly acid liquid, is tri-basic,

forming three classes of salts. It does not coagulate albumin, it yields precipitates with most metallic salts in solution.

It is decomposed by heat, parting with one or two molecules of water formerly held in combination. In its purest form, it is a crystalline solid.

It is manufactured by boiling amorphous phosphorus in nitric acid, and when the phosphorus has entirely dissolved, the liquid is concentrated in platinum vessels until all of the nitric acid passes off, then water is added and the liquid placed over strong sulphuric acid under a bell jar, when all water evaporating, hard transparent crystals of ortho-phosphoric acid remain.

This acid dissolved in water forms strong liquid phosphoric acid of 85% strength.

Dilute phosphoric acid consists of 100cc. of 85% acid and 750cc. of water, and contains 10% of absolute phosphoric acid.

**Differentiate glacial phosphoric acid and common phosphoric acid, and state in what respect the action of the former on the animal system differs from the latter.**

Glacial phosphoric acid has the composition  $P_2O_5 \cdot H_2O = 2HPO_3$ .

Ortho-phosphoric acid (or common phosphoric acid) has the composition  $P_2O_5 \cdot 3H_2O = 2H_3PO_4$ .

Glacial phosphoric acid is usually sold in sticks, resembling caustic potash, but more glass-like in appearance.

Ortho-phosphoric acid of 85% strength is dispensed in liquid form.

Glacial phosphoric acid is poisonous, coagulates albumen, does not give a precipitate with magnesium sulphate, ammonium hydrate and ammonium chloride.

Ortho-phosphoric acid is comparatively harmless, does not coagulate albumen, and forms a precipitate with magnesium sulphate, ammonium hydrate and ammonium chloride.

**What chemical product of bacteria is present in dental**

caries? (a) Does this product act on the mineral salts of the teeth? (b) If so, how?

Lactic acid. (a) Yes. (b) By forming soluble salts attended by loss of tooth structure through solution.

**From what is lactic acid obtained? Describe a process of obtaining lactic acid and state its use in dentistry.**

It is obtained from sour milk and many other organic substances. It is manufactured by allowing fermentation of a mixture of 8 parts cane sugar, 50 parts water, 1 part cheese, 3 parts chalk, to continue for several weeks; this results in the formation of calcium lactate, and this is decomposed on the addition of sulphuric acid and alcohol, when the liquid, decanted, and allowed to stand, loses its alcohol through evaporation, leaving pure lactic acid as a colorless, strongly acid liquid. Its use in dentistry rests largely upon its power to dissolve calcium phosphate and carbonate, and thus to decalcify teeth.

**Name four organic acids.**

Lactic acid, acetic acid, oxalic acid, butyric acid.

**State the composition and properties of oxalic acid. Describe the manufacture of oxalic acid, and mention an antidote for oxalic acid poisoning.**

Oxalic acid  $\text{H}_2\text{C}_2\text{O}_4$ , occurs as colorless, transparent crystals, soluble in water, odorless, very acid, and highly poisonous.

It is manufactured by making a paste of caustic potash, caustic soda and sawdust, and heating this for several hours on iron plates; then boiling the resultant with lime and water, then decomposing the calcium oxalate so formed by adding sulphuric acid, filtering and allowing the liquid to evaporate, when oxalic acid crystallizes.

An antidote for oxalic acid poisoning is chalk or a soluble salt of calcium.

**What is fermentation?**

Fermentation is the decomposition of non-nitrogenous or-



ganic substances produced through the agency of nitrogenous bodies called ferments.

**What are alkaloids? Name three.**

Alkaloids are active principles of organic substances. They all contain nitrogen, and are alkaline in reaction. They are called organic bases. Morphine, strychnine and quinine are three alkaloids.

**What is the source of tartaric acid? Give its use in medicine.**

It is the acid of the grape, occurring as acid tartrate of potassium, and when grape juice undergoes fermentation, this salt being insoluble, forms hard concretions, known as argols, deposited in the casks.

From this substance tartaric acid is manufactured by adding to it lime forming calcium tartrate, and then adding sulphuric acid, filtering and crystallizing tartaric acid from the liquid. In medicine it is used to lower cardiac action and to give acidity to the urine.

**Give the manufacture of chloroform.**

Chloroform is obtained by distilling a mixture of bleaching powder, water, lime and alcohol, and is purified by adding sulphuric acid, decanting, neutralizing with soda and re-distilling with quicklime.

**Mention (a) two disinfectants; (b) two antiseptics. Give an example of the use of each.**

SO<sub>2</sub>, sulphur dioxide and H<sub>2</sub>O<sub>2</sub>, hydrogen peroxide are two disinfectants. Sulphur burned in a room produces SO<sub>2</sub>, which destroys germs. Hydrogen peroxide in official solutions is added to collections of pus, when by direct oxidation, it destroys the germs present.

Bichloride of mercury and boric acid are two antiseptics. The site of an operation, bathed by a solution of one part of bichloride of mercury in 2000 parts of water, renders the field of the operation non-fertile for development of germs. Boric

acid in 3% watery solution applied to the eye prevents the development of germ life.

**(a) Give a brief description of the chemical properties of alcohol. (b) Name its two principal forms. (c) How and from what is each derived?**

(a) Alcohol is a water in each molecule of which one hydrogen atom has been replaced by an alcohol radical or a hydro-carbon radical. It is a neutral substance, inflammable, lighter than water, a marked solvent particularly for gums and resins, is hygroscopic, and when burned yields a large amount of heat.

(b) Methylic or wood alcohol. Ethylic or grain alcohol.

(c) Wood alcohol is obtained by destructive distillation of wood in closed retorts, to the result of which sodium hydrate is added, and this mixture redistilled.

Grain alcohol is obtained by distilling the results of fermentation of starchy or sugary liquids.

**State the formula of (a) common (ethylic) alcohol, (b) sulphuric ether, (c) acetic acid.**

(a)  $C_2H_5OH$ . (b)  $(C_2H_5)_2O$ . (c)  $HC_2H_3O_2$ .

**Mention three alkaloids, giving their uses in dentistry.**

Morphin, as acetate, sulphate or muriate, is used in devitalizing mixtures and as an obtunding agent, and for temporary relief of odontalgia, is used internally for relief of facial neuralgia.

When used as an obtunding agent it is usually combined with carbolic acid and oil of cloves.

Cocain: its salts are used as local anesthetics and anodynes especially in alveolar pyorrhoea, extirpation of pulps of teeth and that of hypersensitive dentine; for extraction of teeth, in lotions for neuralgia and odontalgia.

Atropin, as sulphate used locally as an obtunding agent, etc., and internally for neuralgia, etc.

**State the general, physical and chemical properties of an alkaloid.**

An alkaloid may be liquid but is usually solid. It is usually of crystalline form, generally white in color, but slightly soluble in water, its salts being more soluble, the alkaloid is more soluble in alcohol and ether and most in chloroform. An alkaloid burns with an odor of burning feathers, then chars and finally burns entirely away, leaving no residue. Chemically, all alkaloids contain nitrogen along with carbon and hydrogen: the fixed alkaloids contain oxygen, while volatile alkaloids have no oxygen in their composition. They are all basic, though their salts may be neutral. They combine to form salts with acids without displacing the hydrogen of the acid. They are tertiary and secondary amines, they all form precipitates with tannic acid, with fixed alkalies, and with solutions of some metallic salts.

**Give the chemical constituents of (a) dentine, (b) enamel. State the properties of each constituent mentioned.**

Organic substances and water.....	27.70	3.60
Inorganic substances .....	72.30	96.40
Inorganic substances included in 100 parts of ash :		
Calcic phosphate.....	71.32	93.35
Calcic carbonate .....	1.61	4.80
Calcic oxide.....	5.27	.86
Calcic sulphate .....	.09	.12
Magnesian carbonate .....	.75	.78
Iron oxide .....	.10	.09
		traces of fluorine

Inorganic substances give rigidity, form, hardness, and resistance to tooth structure; organic substances are largely instrumental in the nutrition of the tooth including its blood and nerve supply.

**Define metallurgy.**

Metallurgy is the science that treats of the economical ex-

traction of metals from their ores, and the application of metals to useful purposes. It includes a description of each metal.

**What is metal?**

A metal is an element, usually solid at ordinary temperatures, having considerable weight, being more or less malleable, ductile and tenacious. It possesses lustre, is opaque to light and is a good conductor of heat and electricity. It is electro-positive, is capable of displacing hydrogen from acids to form salts, and will form at least one basic oxide with oxygen.

**Name three metals and give the symbol and atomic weight of each.**

Iron, Fe, 56.

Gold, Au, 196.6.

Aluminum, Al, 27.

**Mention three heavy metals. Give the symbol and atomic weight of each.**

Gold, Au, 196.6.

Platinum, Pt, 197.

Mercury, Hg, 200.

**Name some of the more malleable metals.**

Gold, silver, tin, copper, aluminum, platinum.

**What metal is the best conductor of heat? Of electricity?**

Silver is the best conductor of both heat and electricity.

**Give the atomic weight and the symbol of gold, silver.**

Gold, Au; atomic weight 196.6. Silver, Ag, 108.

**Compare gold, silver, copper and tin as to conductivity of heat.**

Best in conducting power for heat is silver, followed in order by copper, gold and tin.

**Mention the two groups into which metals are divided.**

Noble metals and base metals.

**Differentiate metallic element, metallic compound, and amalgam.**

A metallic element under the action of any force will not give rise to any other substance than its original self. It is electro-positive and exhibits the properties known as metallic.

A metallic compound is one usually consisting of a chemical union of a metal with a non-metallic element or radical, and on its decomposition will yield two or more different substances than its original self, one of which substances will be of metallic character.

An amalgam is a combination of one or more metals with mercury.

**Give the atomic weights and the symbols of (a) three heavy metals, (b) three light metals.**

(a) Osmium, Os, 198.5; iridium, Ir, 192.5; platinum, Pt, 195.4.

(b) Aluminum, Al, 27; magnesium, Mg, 24; potassium, K, 39.

**Give the name and atomic weights of each of the following: Ca, Al, Ni, P, Pt.**

Ca, calcium, 40; Al, aluminum, 27; Ni, nickel, 58; P, phosphorus, 31; Pt, platinum, 195.4.

**Give the comparative thermal and electrical conductivity of gold, silver and tin.**

Conducting power for both heat and electricity is in order, first silver, second gold, third tin, of the metals mentioned.

**Mention some metals having (a) very low fusing points, (b) very high fusing points.**

Metals of low fusing point include mercury, sodium, potassium, tin, lead. (b) Metals of high fusing point include osmium, iridium, platinum, iron, nickel.



**State why an alloy becomes brittle when heated.**

When heated an alloy more readily undergoes oxidation than its component metals by themselves, and the oxides formed dissolve in the remaining metallic substances and by their presence diminish cohesion of the particles of the alloy by preventing perfect contact between those particles.

**State the requisite properties of metals used for dies.**

Hardness, non-contractility on cooling, fusibility at low temperatures, marked cohesiveness or absence of brittleness.

**State two processes of joining metals.**

Welding and soldering.

**Give the comparative thermal and electric conductivity of tin, silver, platinum and gold.**

	<i>Conducts heat</i>	<i>Conducts electricity</i>
Tin .....	14.5	12.36
Silver .....	100	100
Platinum .....	8.4	18.80
Gold .....	53.2	77.96

**Write the names of ten metals used in dentistry. State the proportion that this number of metals bears to the entire number of known metals.**

Gold, platinum, silver, zinc, tin, lead, mercury, iron, copper, bismuth.

These represent about one-sixth the number of known metallic elements.

**Name three metals which are excellent conductors of electricity, heat and cold. Are these properties desirable or objectionable in metal-base dentures? Give reasons.**

Silver, gold, copper.

Such properties are objectionable because their change of volume endangers permanency of the denture and of the union of teeth to the plate; as conductors of heat and electricity such metals cause irritation to sensitive parts, are apt to induce galvanic conditions in the mouth when filled teeth

are also present, and affect the remaining healthy teeth from sudden changes of temperature.

**Explain the differences between annealing and tempering metals, and give an example of each process.**

Annealing a metal consists in heating it to a red heat and then (usually) letting it slowly cool.

This process of annealing, or softening a metal, allows the molecules that have been forced into unnatural positions by hammering, etc., to again become normally related to each other. It restores lost malleability and ductility.

Tempering a metal is usually performed by first heating the metal to redness and cooling instantly as by plunging in cold water—this makes the metal hard and brittle; the metal is then slowly heated to a particular temperature, considerably below redness, and is then cooled quickly, the result being to remove some but not all of the hardness occasioned by its initial heating.

Example of annealing:—Gold after hammering becomes hard and brittle but when heated to redness and allowed to cool slowly in the air its softness and malleability is again restored.

Example of tempering:—A dental instrument (lancet) after manufacture is first heated to cherry-red heat and then cooled by plunging in cold water; it may then be heated in the flame of a spirit lamp at some distance from its cutting edge and rotated while in the flame so as to heat all parts equally until the end of the instrument acquires a pale straw color due to the formation of a thin film of oxide (indicating a temperature of about 430° F.) when it is at once plunged into cold water.

**Place the chemical symbols after each of the following elements: Lead, tin, aluminum, antimony, nickel.**

Lead, Pb.; tin, Sn.; aluminum, Al.; antimony, Sb.; nickel, Ni.

**Place after each of the following metals its chemical symbol: Gold, platinum, silver, tin, and copper.**

Gold, Au.; platinum, Pt.; silver, Ag.; tin, Sn.; copper, Cu.

**Name five metals all of which can be manufactured into wire, sheet, or foil.**

Gold, silver, platinum, copper, aluminum.

**What constitutes the difference between a noble metal and a base metal? Give examples of each.**

A noble metal is one having so feeble an affinity for oxygen as to be incapable of rusting or tarnishing by oxidation in air when cold or heated, and whose oxide when formed can be decomposed by heat alone at temperatures not above a red heat.

Among noble metals are gold, mercury, silver, platinum, iridium.

A base metal is one which oxidizes in air at ordinary temperatures, or when heated, and whose oxide requires heating at a high temperature with the presence of a reducing agent in order to undergo decomposition.

Among base metals we find lead, tin, zinc, iron, copper.

**Mention the only three metals which are attracted to the magnet and which can themselves become magnets.**

Iron, nickel and cobalt.

**Describe five metals and give the fusing point of each.**

Tin (fusing point,  $442^{\circ}$  F.) is a soft, silvery-white, malleable metal, and is present in solder. It readily volatilizes when heated.

Lead (fusing point,  $617^{\circ}$  F.) is a bluish, soft, malleable, ductile metal; is slightly tenacious, resists the action of sulphuric acid, undergoes oxidation when melted.

Zinc (fusing point,  $779^{\circ}$  F.) is a silver-white, highly crystalline, brittle metal; it is ductile and malleable when heated to certain temperatures. It is used in solder, and its oxide, forming when the metal is burned, enters into the composition of dental cements.

Gold (fusing point,  $2012^{\circ}$  F.) is a yellow, soft, most malleable and ductile metal, is insoluble in single acids, does not oxidize in air, and is markedly cohesive, welding when cold.

Copper (fusing point,  $2192^{\circ}$  F.) is a flesh-colored, or reddish, malleable metal, harder than gold; it is ductile, tenacious and tough; is after silver the next best conductor of both heat and electricity, it enters into the formation of many important alloys, like brass, bronze, german silver.

**What special properties of metals are most affected by alloying?**

Malleability and ductility are lessened, tenacity and hardness are increased, fusibility is lowered, sonorousness is increased.

**How does alloying affect the ductility of the noble metals?**

If noble metals are alloyed with base metals ductility is markedly lessened.

A few noble metals like gold and platinum, or platinum and iridium are ductile when alloyed. The general rule is that the ductility of alloys is less than that of the constituent metals.

**How does alloying a pure metal usually affect its (a) tenacity, (b) ductility, (c) malleability?**

(a) Tenacity is increased, (b) ductility is lessened, (c) malleability is lessened.

**What metals and alloys are used for dies and counter-dies? State for which each is best adapted.**

<i>Dies</i>	<i>Counter-dies</i>
Type metal of $Pb_3Sb_1Sn_1$ used with	Lead
Zinc used with	Type metal
Babbitt's metal $Cu_1Sb_2Sn_8$ or,	
Babbitt's metal $Cu_1Sb_2Sn_{24}$ used with	Lead
Haskell's metal $Cu_1Sb_2Sn_4$ used with	Lead 5, tin 1
Tin 5, antimony 1.	
Lead, tin, bismuth, antimony, cast iron.	

**What conditions are essential for the perfect welding of metals, whether hot or cold?**

Perfect cleanliness.

Freedom from oxidation, or deposits of metallie salts.

Application of considerable compressing force.

Selection of the proper metals.

**Describe the difference between welding and soldering metals. (b) Is a new alloy formed of the metal and solder at the lines of union?**

Soldering is a process by which two or more pieces of metals are united by means of a fusible alloy termed a solder. It always requires the application of heat and does not require the exertion of a compressing force, and in its performance it is customary to employ a flux, and, as a rule, the union effected by it is less firm than that brought about by welding.

Often in soldering, different metals or alloys may be joined to each other.

In welding, like metals are united through the exertion of considerable force without the use of a fusible alloy, and frequently without the application of heat, and with no necessity for use of a flux.

(b) Yes.

**Why is a flux used in soldering metals? Name two substances so employed.**

To assist the flowing of solder and metal, and promote their intimate union by preventing oxidation, and dissolving, and removing oxides of metals, if formed between opposed surfaces.

Among fluxes we have fused borax, a strong solution of zinc chloride.

**In making dental alloy, state the order of fusing the metals so that volatilization of the base metal may be prevented.**

Melt the highest fusing metal first. Protect its surface well with charcoal or borax. Add the other metals in the order



of their fusing points, the lowest fusing metal being added last.

**Give the approximate composition of brass and of German silver.**

Nickel, 10 to 20 parts	} Form German Silver
Zinc, 20 to 30 parts	
Copper, 50 to 60 parts	

Brass is an alloy of from 60 to 70 parts of copper, with 30 to 40 parts of zinc.

**Define the term amalgam.**

An amalgam is an alloy of two or more metals, one of which is mercury.

**What are the advantages of annealing alloys for dental amalgam? Describe the process.**

To reduce brittleness, and again soften the alloy by removing the hardness and molecular changes produced in making and in cutting the alloy.

At times, to change the character of the alloy, and to secure a uniformity of it. The substances are heated and then allowed to slowly cool, the process being the inverse of tempering. Sometimes alloys are annealed by boiling in water.

**In uniting platinum to platinum, what would you use as a solder and why?**

Pure gold, for ordinary gold solders do not make a strong joint, and for other reasons are not suitable, while pure gold readily alloys with platinum, melts below the fusing point of platinum, gives a strong and permanent union, and acquires a color like platinum.

**What properties does platinum impart to its alloy with gold?**

Elasticity, gives greater strength, increased hardness, increases the ductility of platinum, lowers the fusing point of platinum, gives gold a paler color.

**Describe two different processes for fusing platinum.**

Place it in a cavity in asbestos or magnesium block, through which introduce jets of hydrogen and oxygen gases and light.

Fuse it in electric furnaces between the terminals of the electric arc.

**Describe iridium. (a) With what other metal is it combined for dental use? (b) What are the advantages of these combinations?**

It is a white, lustrous, steel-like metal, slightly heavier than platinum, specific gravity, 22.4. It is not acted upon by air at ordinary temperatures. It is very hard and brittle when cold but becomes malleable at bright red heat. It requires the oxy-hydrogen flame for its fusion. Ordinary acids and aqua regia do not act upon it.

(a) With platinum, to which it gives increased stiffness, hardness, and elasticity.

(b) It also alloys with most metals giving hardness, rigidity and unalterable character to the alloy, as in certain dental instruments.

**What is arsenic? How is it obtained? Give some of its poisonous effects and name antidotes.**

Arsenic is arsenious anhydride,  $\text{As}_2\text{O}_3$ , known commercially as "White Arsenic."

It is obtained from the flues of smelting works that reduce ores of many metals, particularly copper, nickel, zinc, and iron, in the ores of which the element arsenicum is generally found in combination with sulphur.

The sweepings from such flues are subjected to sublimation when pure arsenic results as a sublimate.

Arsenic is a gastro-intestinal irritant and a corrosive poison, and produces as characteristic symptoms a sweet, metallic, then nauseous taste, with intense burning pain extending from fauces to pit of the stomach, accompanied by vomiting and great thirst; then follow peculiar nervous symptoms, but delirium is absent.

Chronic arsenical poisoning is shown by white, pasty complexion, following later by different forms of skin eruptions, and anesthetic areas, accompanied by progressive emaciation and anaemia and local edemas.

Antidotes, freshly prepared hydrated sesqui-oxide of iron with magnesium. Dialized iron.

**Give a test for arsenic, antimony, gold.**

Reinch's Test for arsenic:—A thin piece of pure copper, having a bright metallic surface placed in a strongly acidified solution of arsenic becomes, upon heating the solution, coated with a dark steel-gray deposit of arsenicum, which can be vaporized by the application of heat, when combining with air, forms as a sublimate octahedral crystals of the tri-oxide, which crystals dissolving in water give yellow precipitate with ammonio-nitrate of silver solutions; or green precipitate with ammonio-sulphate of copper solutions.

Test for antimony:—Add hydrogen sulphide to an acidified solution of antimony, an orange-red precipitate of the sulphide of antimony forms, which is soluble in solutions of alkaline sulphides.

Test for gold:—Add hydrogen sulphide to a solution of gold; brown auric sulphide is precipitated, which is soluble in yellow ammonium sulphide.

**Give a short description of gold and its dental uses.**

It generally occurs native, always accompanied with silver. It is usually separated from soil, rocks, etc., by washing with water and amalgamating. It is obtained pure by parting the relatively pure gold from silver, copper and other metals by the use of acids, or by roasting the impure gold with potassium nitrate. It is yellow, specific gravity is 19.4, does not tarnish in air, nor oxidize directly. It ranks first in order of malleability and ductility, and fifth in tenacity. It is not as soft as lead but softer than copper. It welds when cold and is not dissolved by a single acid, except when heated with strong selenic acid.

In dentistry it is used as foil for filling teeth, when pure for soldering platinum, alloyed with copper and silver and platinum it is used as base for artificial dentures. Its elastic alloy with platinum is used for clasps and springs.

**What metals are used to alloy gold for clasps and springs?**

Platinum, silver, copper.

**Describe a method of (a) refining gold sweepings and filings, (b) separating gold from platinum.**

(a) First pass a magnet through the material to remove fragments of iron or steel, then melt in a graphite crucible with borax and nitre, then alloy the resultant with three times its weight of silver and granulate this alloy, then boil these granulations in strong sulphuric acid, wash the resulting brown powder of gold, melt and cast into ingots.

(b) Dissolve the alloy of gold and platinum in aqua regia, boil off as much acid as possible, dilute with distilled water, add ammonium chloride and alcohol, separate the precipitate of platinum-ammonium chloride by filtering, add to the filtrate ferrous sulphate solution, collect the brown precipitate of gold, wash well with dilute hydrochloric acid, then with water, dry and fuse with potassium carbonate and mould in an ingot.

**Give two methods for refining gold.**

The roasting process: Impure gold is placed in a graphite crucible that has been well boraxed, its surface covered with potassium carbonate, it is heated to fusion, when a mixture of potassium nitrate and borax is added from time to time; after roasting for from one half hour to an hour and a half, base metals are oxidized and the resulting refined gold is poured into a mould.

The wet method: Add approximately three times as much silver as we have of gold, fuse, cool, roll out and digest in nitric or sulphuric acid when heated, when gold, left undissolved, may be washed, fused and moulded.

**When gold and amalgam are used in approximal cavities, which metal has the greater effect on the surrounding dentine?**

Gold.

**State the conditions that generate galvanic currents between gold and amalgam filings, and the conditions under which such currents may be avoided. In case of galvanic currents, which metal, gold or amalgam, most affects the pulp?**

If gold and amalgam fillings be in contiguous teeth so as to be nearly in contact and there be an acid salivary secretion, galvanism may occur. Currents may be avoided by not bringing different metals close together, by neutralizing acid saliva, and by selecting metals for the amalgam that are not widely different in their electric potential conditions from gold.

Under the influence of galvanism gold affects the pulp most.

**Why do we find the quality of cohesiveness more marked in gold than in silver, copper and lead?**

Because gold metal is of a closer texture than the others, having a fern-like interlacing crystalline structure. It does not oxidize directly, and is probably not volatile. It has the power of welding when cold, and surface absorption of gases is readily removed by heating.

**What does the term "carat" signify?**

The term "carat" refers to the proportionate amount of pure gold in a gold alloy. Thus pure gold is said to be of 24 carat, while 18-carat gold is composed of 18 parts of pure gold, and 6 parts of alloying metal.

**How do you find the carat?**

By using the following proportion example: As the weight of the alloyed mass is to the weight of gold it contains, so is 24 to the standard sought.

Or, make use of a touch-stone with its accompanying gold



points of different degrees of purity, employing the customary acids.

gold 6  
 What carat would silver 2 } be?  
 copper 1

9:6::24:X; X=16. Ans.

**How do you reduce from higher to lower carat?**

Add to the gold of higher carat copper or silver or both, employing the following proportion example to obtain the required quantity of alloying metal. As the required carat is to the carat used, so is the weight used to the weight of the alloyed mass when reduced—when, the weight of the mass used subtracted from this will give the quantity of alloy to be added; example; Reduce 4oz. of 20-carat gold to 16-carat. 16:20::4 oz.: X = 5 oz. and 5 oz. — 4 oz. = 1 oz. alloy to be added.

**How do you raise gold from lower to higher carat?**

Add pure gold or a gold alloy richer in gold than the one to be raised.

Rule: As the alloy in the required carat is to the alloy in the given carat so is the weight of the alloyed gold to the weight of the reduced alloy required, then the weight of the alloyed gold used, subtracted from this, gives the amount of pure gold to be added.

Example: Reduce one dwt. of 16-carat gold to 18-carat?

First subtract both 16 and 18 from 24 to find the alloy in each carat, then 6:8::1dwt.:X =  $1\frac{1}{3}$  dwt., then  $1\frac{1}{3}$  dwt. — 1 dwt =  $\frac{1}{3}$  dwt. pure gold to add.

**Describe the process of alloying pure gold to make it suitable for 20-carat base plate. (b) State the proportion of each ingredient metal.**

Anneal a plumbago crucible while held inverted, then add the metals, on top of which place a small quantity of pow-

dered charcoal, cover crucible with lid. Heat to a bright red heat and when melted stir with a red-hot iron rod, pouring as soon as possible after fusion. Grease the ingot mould and cast the metal, and then roll and hammer into sheets.

(b) Pure gold, 20 dwt.; copper, 2 dwt.; silver, 1 dwt.; platinum, 1 dwt.

**How would you distinguish a bar or a plate of tin from a metal similar in appearance?**

By its producing a creaking noise when bent, which is known as the "tin cry," and is due to the crystalline character of the interior of the metal bar.

**Mention a solvent for gold and platinum. Give formula.**

Aqua Regia;  $3\text{HCl} + \text{HNO}_3 = 2\text{H}_2\text{O} + \text{NOCl} + \text{Cl}_2$ .

Or,  $3\text{HCl} + \text{HNO}_3 = 2\text{H}_2\text{O} + \text{NOCl}_2 + \text{Cl}$ .

**State the chemical action that causes teeth clasped with gold to decay beneath the gold more quickly than those clasped with rubber.**

The gold clasp causes more attrition of tooth structure, fits less snugly allowing space for accumulation of material and its subsequent decomposition, with accompanying bacterial activity, while the rubber clasp slowly parting with sulphur, gives constantly germicidal and antiseptic protection from the sulphur dioxide that is formed.

**Explain how pure gold can be obtained from mixtures, alloys, and solutions containing gold and other substances.**

If material is liquid evaporate until dry, then, first remove iron and steel by magnet; second, roast in well boraxed crucible with potassium nitrate and cast in ingot; third, remelt, fusing with three times its weight of silver, and granulate this alloy; fourth, boil these granulations in sulphuric acid, wash, then dissolve in aqua regia, precipitate platinum by adding ammonium chloride and alcohol, then to the liquid add ferrous sulphate, wash the resulting precipitate in hydro-

chloric acid, then in water, melt with potassium carbonate, and mould in greased ingot mould.

**Name several metals which readily impair or destroy the malleability and ductility of gold.**

Tin, lead, antimony, bismuth, arsenic.

**Give the physical properties of silver, and state its most important salt. Define the use in dentistry of silver.**

It is the whitest of metals, is brilliant and next to gold, most ductile and malleable. Is harder than gold, not so hard as copper. Fuses at  $1904^{\circ}$  F., has a specific gravity of 10.4. It is the best conductor of heat and electricity, volatile at full red heat, its vapor is blue. When fused it absorbs oxygen, which escapes as the metal cools, causing a roughened surface. Is not acted upon by pure air or moisture, but combines directly with sulphur, phosphorus, or chlorine.

Its most important salt is argentic nitrate  $\text{AgNO}_3$ .

Use of silver in dentistry: Alloyed with platinum forming dental-alloy, it is used for making base for artificial dentures and for crown and bridge work. Silver and tin are the two essential metals in all good dental amalgam alloys. An alloy of silver, copper and platinum is often used for base plate. Silver enters largely into the composition of dental solders.

**Describe a method of obtaining silver from one of its native ores.**

Amalgamation Process for silver sulphide reduction:

Ore is crushed and roasted with common salt at dull red heat, when silver chloride and sodium sulphate result.

This mixture is placed in barrels with water, scrap iron, and mercury, and the barrels rotated, when ferrous chloride and metallic silver result—the metal silver at once amalgamates with the mercury, and this amalgam, from its greater weight, sinking below the dross, is run off, squeezed in bags until solid, and distilled in iron retorts, when the mercury is recovered and the silver, more or less impure, is left in the

retort. This impure silver may then be mixed with lead and heated in a cupel furnace when silver of a fair degree of purity is obtained.

**Describe silver nitrate and give its chemical formula.**

Silver nitrate, formula  $\text{AgNO}_3$ , crystallizes in colorless, right rhombic plates, soluble in its own weight of water, turns black on contact with organic matter, fuses readily unchanged and can be cast in moulds and in this form the impure salt is known as "Lunar Caustic." It is a corrosive and irritant poison, its antidote is common salt, or a soluble chloride. It is astringent, alterative, and caustic in action.

**Explain the chemical process for recovering pure silver from refuse amalgam.**

Heat the amalgam at red heat for some time to get rid of as much mercury as possible, then granulate and dissolve the metal in 50% strength nitric acid; decant from any insoluble residue, and, to the clear liquid add solution of sodium chloride. Wash the resulting precipitate of silver chloride, place it in a clean beaker with twice its bulk of distilled water, acidulate the liquid with sulphuric acid and in it place pure iron, as in the form of nails. Stir this mixture and when the precipitate becomes of a uniform gray color remove the iron, filter, wash the precipitate with well-diluted hydrochloric acid, and then with water. Dry the gray deposit and fuse in a crucible that has been boraxed, with potassium carbonate, and when melted pour in an ingot mould.

**What salt of silver is used in dentistry? Give its formula.**

Silver nitrate. Its formula is  $\text{AgNO}_3$ .

**Would you use silver in making plates? Why?**

No. From its softness and flexibility and its affinity for sulphur it is unfitted for plates when pure. When alloyed with platinum, it is used as a base for artificial dentures. It is generally alloyed with gold for use in dentistry.

**Mention the chief source of sodium. Give the principal reactions of sodium.**

Sodium occurs most abundantly as the chloride, existing as such in animal, vegetable and mineral structures. The metal sodium is generally obtained by distilling sodium carbonate and charcoal in iron retorts. Sodium or its compounds, when heated in the inner Bunsen flame color the outer flame yellow. Its compounds are, in nearly all instances, soluble in water.

**(a) What is sodium silicate? (b) Mention the use of sodium silicate in dentistry.**

Sodium silicate,  $\text{Na}_2\text{SiO}_3$ , is known as soluble glass and is obtained by strongly heating equal weights of sodium carbonate and sand, and dissolving the resultant in boiling water, this yielding a solution of sodium silicate in water.

(b) Is applied to bandages which, on drying, forms a perfect cast of the part so that such stiffened bandage when cut and removed may be used as a splint, as in fracture of the jaw.

**Mention the properties and give the composition of cast-iron.**

Cast-iron is gray in color, brittle, melts at much lower temperature than wrought iron, contracts but little on cooling from fusion, is hard, has been used for dies for dental purposes.

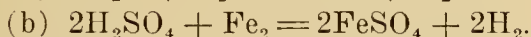
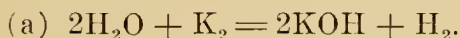
Its composition varies but it usually contains from 2 to 4% of carbon, two-tenths to three per cent. of silicon, less than 2% of manganese and small quantities of sulphur and phosphorus.

**Name three salts of iron and place the chemical formula after each.**

Ferric chloride,  $\text{Fe}_2\text{Cl}_6$ ; ferric sulphate,  $\text{Fe}_2(\text{SO}_4)_3$ ; ferrous sulphate,  $\text{FeSO}_4$ .



**Illustrate by symbols (formulae) the decomposition of (a) water by potassium, (b) sulphuric acid by iron.**



**What salt of iron is used as an antidote for arsenic poisoning? State how this salt may be rapidly prepared.**

Freshly prepared hydrated sesqui-oxide of iron with magnesium. This may be obtained by adding to any ferric salt of iron, like ferric sulphate in solution, calcined magnesia; or by adding ammonia water to the solution of iron salt, quickly washing the precipitate with water, and squeezing it in a rag.

**By what simple treatment can a hard steel instrument be softened? How may softened steel be again hardened?**

Soften a hard steel instrument by heating to about a cherry red heat, and then allowing it to cool slowly.

To harden steel heat it to redness and cool very quickly, as by plunging in cold water.

**Describe the method of tempering steel instruments.**

The instrument is first heated red hot, then plunged in water. It is then placed in a sand bath, leaving but a minute point of the instrument exposed to view; heat is then gradually applied to the sand bath until the desired temperature, generally less than  $500^\circ \text{F.}$ , indicated by the color that the instrument assumes, is reached, when the instrument is cooled quickly by immersing in water, acid, or oil.

**What do you know about mercury as a metal?**

It is the only metal liquid at ordinary temperatures, and is silver white. Specific gravity is 13.6, it does not tarnish in air, it dissolves all metals except iron, forming amalgams. Is soluble in acids.

**How are the impurities of mercury detected and how readily removed?**

A globule of pure mercury should be round. If it assumes an elongated shape or leaves a mark as it passes over a smooth white surface, or if it undergoes oxidation at ordinary temperatures in air, it is impure. To purify, distil mercury after covering its surface with iron filings; or, add to mercury nitric acid and after contact for 24 hours, pour off the liquid and wash the mercury with water.

**Name some of the metals for which mercury possesses a great affinity.**

Tin, gold, silver, lead, zinc, copper.

**Mention the important ore of mercury and describe the process by which this metal is obtained from this ore.**

Cinnabar,  $\text{HgS}$ .

This ore is heated in a kiln or furnace to which are connected large condensing chambers into which  $\text{SO}_2$  gas and mercury vapor pass, the latter condensing.

The metal so obtained needs purifying, to remove from it other metals usually contaminating it.

**Describe the properties of copper amalgam. Name some of its advantages and disadvantages.**

Obtained by direct union or, preferably, by electrolytic deposition.

At first soft and plastic, after a few hours standing becomes hard and crystalline, but may be again softened on heating.

Though hard, it is malleable, can be polished, retains its lustre in air, but darkens on contact with sulphuretted hydrogen. Does not expand on hardening.

Advantages of copper amalgam: Such fillings retain good margins, are very hard and rigid, do not contract, but slightly expand on setting and perfectly seal the cavity.

Exerts beneficial effect on tooth structure.

Disadvantages: Becomes bluish-black, undergoes surface disintegration.

**Name and describe two salts of mercury and give the formula of each.**

Calomel, or mild chloride of mercury, or mercurous chloride.

A white amorphous powder sublimes without fusing, insoluble in water and alcohol, used as a mild laxative in single dose of 10 grs., is not poisonous, formula  $\text{Hg}_2\text{Cl}_2$ , or  $\text{HgCl}$ .

Corrosive sublimate, corrosive chloride of mercury, mercuric chloride, bichloride of mercury: It is a white crystalline salt, soluble in water, alcohol and ether. It is a corrosive and highly poisonous substance, one twenty-fourth of a grain constituting a large single dose. It is extensively used as an antiseptic, when in solution in 2000 to 5000 parts of water. Used internally as an alterative. Its formula is  $\text{HgCl}_2$ .

**State some of the general uses of mercury. (a) How may it act as an irritant poison? (b) What precautions should be observed for safety?**

Used in construction of thermometers, barometers, manometers, to measure the capacity of vessels, its amalgam with tin or silver used to make mirrors, used to amalgamate zincs of a battery, used finely divided as with chalk in medicine.

(a) In finely divided state it may form soluble salts of poisonous nature, as mercuric chloride, from the action upon it of hydrochloric acid in gastric juice, or may produce organic compounds of a soluble nature, or its vapor, constantly inhaled, may occasion a form of chronic poisoning from its ready conversion into mercurial compounds.

(b) Obtain perfect cleanliness after its use, thorough ventilation in rooms in which its vapor escapes; if the slightest symptoms of ptyalism appear, stop any further ingestion of the substance and use astringent mouth washes; take internally potassium iodide to facilitate the elimination of mercury from the system.

**State the conditions under which amalgam would be improved by washing.**

When there are present oily or fatty matters or dirt, from manipulation in the hand, or oxides or other metallic salts accidentally produced, washing amalgam in water, alcohol, ether or chloroform has been recommended.

**Distinguish between the effects produced upon pulps by (a) inserting in the same cavity a compound filling of gold and amalgam, (b) filling approximal cavities, one with gold and the other with amalgam. Give reasons for the different effects.**

(a) If the compound filling be perfect, so that no fluid reaches its interior, no galvanic action takes place, and the tooth pulp is preserved. If on the other hand fluid penetrates the filling, galvanic action takes place leading to destruction of the pulp.

(b) If the two fillings are in contact at any point galvanic action will occur, should the saliva become acid, and lead to a destruction of the pulp most marked in the tooth filled with gold.

**Describe the chemical process involved in the setting of amalgam.**

When an amalgam has been produced the mercury at once begins to combine chemically with the metal or metals present. That this combination is a chemical one is shown by the occurrence of crystallization, the evolution of heat, and the extruding or forcing from the solidifying mass of the excess of mercury.

**What important properties should amalgams for filling cavities in teeth possess?**

A permanency of form, hard, dense and sufficiently tough to resist attrition, with edge strength and sharpness of edge, should offer perfect resistance to oral secretions and food, and be free from any metal that would favor the formation of injurious soluble salts, and should retain a good color.

**Describe (a) negative metallic fillings, (b) positive metallic fillings.**

A negative metallic filling would be one containing such metals as are weakest in their ordinary electro-positive conditions, while the positive metallic filling would be formed of the strongest electro-positive metals; thus, if we make a list of metals like Au, Pt, Pd, Sb, Hg, Ag, Cu, Bi, Pb, Ni, Fe, Sn, Cd, Zn, Al, such fillings containing metals from the last half would be positive fillings while those composed of metals selected from the first half would form negative fillings.

**By what chemical tests is the presence of lead recognized in solution?**

Hydrochloric acid gives a white precipitate of lead chloride soluble in boiling water.

Hydrogen sulphide gives a black precipitate of lead sulphide insoluble in ammonium sulphide.

Sulphuric acid gives a white precipitate of lead sulphate.

Potassic chromate gives yellow lead chromate.

Alkaline carbonates give, with lead, white precipitates of basic carbonates.

**How is aluminum obtained? Give its symbol and atomic weight.**

By heating in reverberatory furnace, ten parts of double chloride of aluminum and sodium, five parts of double fluoride of aluminum and sodium, and two parts of metallic sodium; or, by the electrolysis of a fused aluminum ore.

Symbol is Al. Atomic weight is 27.

**(a) Describe the general properties of aluminum. (b) How is it employed in dentistry. (c) Why is its use limited?**

(a) It is almost as white as silver, is but two and one-half times the weight of water, is not acted upon by air, even where hydrogen sulphide is present, and so does not darken on exposure like silver, is extremely malleable and ductile, is very



sonorous, is a good conductor of heat and electricity, melts at about  $1150^{\circ}$  F., is not acted upon by the vegetable acids, dissolves in solutions of caustic soda or potash, and in hydrochloric acid.

(b) Is used as a base in connection with rubber or celluloid by which the teeth are attached—an alloy of copper and aluminum has been used as a base. Many dental appliances (trays, instruments, etc.) may be made of aluminum.

(c) Its use is limited because of its ready solubility in alkaline solution, its great contraction after cooling, the difficulty of soldering it, the readiness with which it oxidizes when finely divided as in amalgams, and its attendant enormous swelling and marked chemical action.

**Why cannot amalgam of aluminum and mercury be employed to fill cavities in teeth?**

Aluminum amalgam is unsatisfactory from the readiness with which oxidation takes place, its great expansion on setting, marked chemical action that occurs on amalgamating, liberation of much heat.

**What are the chemical and physical properties of asbestos?**

Asbestos, or amianth, is a fibrous silicate of calcium and magnesium, the length of the fibres being from less than one inch to five feet. A single fibre can be fused, but any considerable collection of fibres is practically infusible. It is a bad conductor of heat, it is unaffected by acids, may be woven into cloth. Is used as covering to prevent radiation, as from flues, and to prevent communication of heat to combustible substances, for filtering strongly acid liquids, etc.

**Mention two important ores of zinc, and describe the process by which the metal is obtained from one of the ores.**

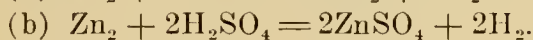
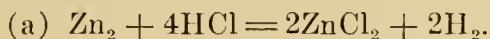
Calamine or native carbonate,  $\text{ZnCO}_3$ .

Zinc blende,  $\text{ZnS}$ .

Calamine is first roasted in air, forming zinc oxide and  $\text{CO}_2$

gas. The zinc oxide is then mixed with charcoal or coke, in earthenware retorts, and is subjected to downward distillation, when the vapor of the metal solidifies, yielding zinc.

**Write the equation showing the reaction of (a) hydrochloric acid on zinc. (b) Sulphuric acid on zinc.**



**Give the properties of metallic zinc and state its uses in dentistry.**

It is a bluish-white metal, melts  $779^\circ \text{ F.}$  specific gravity 6.9, is brittle and crystalline. When heated to  $212^\circ$  to  $302^\circ \text{ F.}$  becomes ductile and malleable, retaining its malleability after cooling. When heated to  $400^\circ \text{ F.}$ , it again becomes brittle so that it can be powdered. It is volatile, and on heating, burns to form the oxide of zinc. It contracts markedly on cooling after heating, is harder than gold or silver, does not oxidize in air or moisture at ordinary temperatures.

Used in dentistry for making dies for swaging metal plates, less often is used to make counter-dies. It is often a constituent of solders, and in the form of brass is frequently added to gold in making solder. Its oxide, chloride, and sulphate enter into the composition of dental cements. Zinc chloride is used in dentistry as a disinfectant and obtunding agent. Its sulphate is astringent and emetic. Zinc is often added to alloy amalgams.

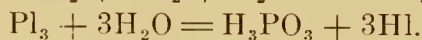
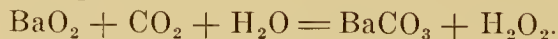
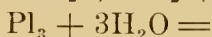
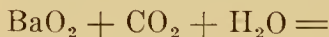
**Distinguish chemically between oxy-chloride of zinc and phosphate (oxy-phosphate of zinc). State the conditions indicating the use of each in dentistry.**

The liquid used in oxy-chloride of zinc cement is a solution of one oz. zinc chloride dissolved in 5 or 6 drams of water; the powder is calcined pure zinc oxide with a small amount of borax and silica added.

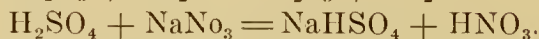
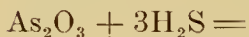
The liquid used in oxy-phosphate of zinc cement is made by evaporating a solution of glacial phosphoric acid in water to a syrupy consistency; the powder is pure calcined zinc oxide.

Oxy-chloride of zinc cement is not permanent, sets slowly, shrinks markedly, is antiseptic, and is used for filling, lining, and restoring color to teeth. Oxy-phosphate of zinc cement is more permanent, lasting from two to seven years and is less irritating.

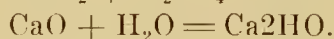
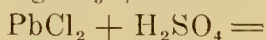
**Complete the following equations:**



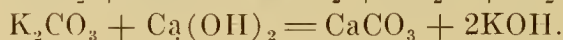
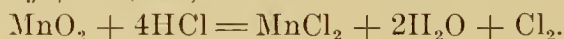
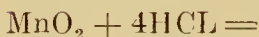
**Complete the following equations:**



**Form complete equations of the following:**



**Complete the following equations:**



**State the chemical names of the following compounds:**



KI, potassic iodide;  $\text{CaSO}_4$ , calcic sulphate;  $\text{HgCl}_2$ , mercuric bichloride; FeO, ferrous oxide;  $\text{NH}_4\text{OH}$ , ammoniac hydroxide.

**Write the chemical name of each of the following:**  
**White lead, gypsum, calomel, copperas, blue vitriol.**

White lead is basic plumbic carbonate.

Gypsum is natural calcic sulphate.

Calomel is mercurous proto chloride.

Copperas is ferrous sulphate.

Blue vitriol is cupric sulphate.

**Write the chemical name of each of the following:**  
**Muriatic acid, quick-lime, salt, cinnabar, Epsom salts.**

Muriatic acid is hydrogen chloride or hydrochloric acid.

Quicklime is calcium oxide.

Salt is sodium chloride.

Cinnabar is mercuric sulphide.

Epsom salts is magnesian sulphate.

**State approximately the number of (a) inches in one meter, (b) grains in one gram.**

(a) 39.34 inches. (b) 15.432 grains.

**What is a liter? What fraction of a meter is a millimeter?**

A liter is equivalent in measure to 33.81 English fluid-ounces, is the unit in the metric system for measuring capacities, will contain 1000 cubic centimeters, and, if of cubical form, would measure on each side one decimeter or 3.937 inches in length.

A millimeter is the one thousandth part of a meter.

**Convert 36 C into the corresponding reading F.**

$$36^{\circ}\text{C} \times \frac{9}{5} = 64\frac{4}{5} + 32 = 96\frac{4}{5}^{\circ}\text{F}, \text{ Ans.}$$

**Mention the standard of measure in the Metric System and state how this standard was determined.**

The meter, selected because it represents the one ten-millionth of the distance from the earth's equator to either north or south pole.

**Define ohm, ampere, volt.**

The ohm is the unit of electric resistance, and is equal to the resistance to the electric current offered by 250 feet of pure copper wire of  $\frac{1}{32}$  inch diameter.

The ampere is the unit of current strength (electric), and electric energy having an electro-motive force of one volt encountering a resistance of one ohm will then exhibit a current strength of this unit one ampere.

A volt is the unit of electro motive force, and represents a tension or pressure required to maintain a current of one ampere through a resistance of one ohm.

**Define acid, base, salt, neutral salt.**

An acid is a sour substance, always containing hydrogen, capable of uniting with and neutralizing a base to form a salt and water, often having a corrosive action upon the tissues, and turning litmus to a red color, and bleaching organic substances.

A base is the oxid or hydrate of a metal (or electro positive radical) which combines with and neutralizes acids to form salts and water, emulsifies fats forming soaps, has a harsh acrid taste; if soluble, its solution gives blue color to litmus.

A salt is a substance formed by replacing all or part of the hydrogen of an acid with metal atoms (or electro positive radicals).

A neutral salt is one which when in solution would fail to change litmus in color.

**Define allotropism, nascent state, crystalline, structure, amorphism.**

Allotropism refers to the condition in which substances alike in chemical composition may exhibit different properties; as we find in red and in yellow phosphorus.

The nascent state refers to a freshly produced condition of an element in which it has been supposed that the component atoms have not as yet united to form molecules.

By crystalline structure we mean that the molecules or par-



ticles of a substance are arranged in definite geometrical forms.

Amorphism indicates lack of crystalline structure.

**Define lixiviation.**

Lixiviation consists in washing wood ashes and other porous substances with water so as to dissolve out certain salts (like potassium carbonate) from the porous material.

**Define radical.**

A radical is an atom uncombined; a compound radical is a group of atoms with their respective valencies unsatisfied, and it enters into chemical changes like an elementary atom.

**Describe the effect produced by increasing the vibration of the molecules of a mass.**

1. Rise of temperature.
2. Internal work  $\left\{ \begin{array}{l} \text{Increase in volume.} \\ \text{Change of state.} \end{array} \right.$
3. External work  $\left\{ \begin{array}{l} \text{Overcoming pressure.} \end{array} \right.$

**Explain each of the following: Reflection of light, refraction of light, dispersion of light.**

Reflection of light is the rebounding of light from a polished surface.

Refraction of light is the bending or change of direction of light rays on passing from a medium of one density into a medium of different density.

Dispersion of light is the splitting of white light into the colors of the spectrum.

**Define five of the following: Alloy, precipitate, amalgam, allotropism, reagent, isomerism, chemism.**

An alloy is the union of two or more metals usually effected by fusion.

A precipitate is a new insoluble substance formed, through chemical action, on bringing in contact solutions of appropriate substances.

An amalgam is an alloy in which one of the component metals is mercury.

A reagent is an active chemical substance, usually in solution, which exerts chemical action upon substances to which it is added.

Isomerism refers to that condition in which two or more substances, composed of the same elements, in the same percentage composition, may be distinctly different substances exhibiting different properties.

**Mention the chief substances that serve as plant food.**

Water,  $\text{CO}_2$ , ammonia, potassium and sodium salts, phosphates of calcium and magnesium, silicates of potassium and sodium.

**Describe the formation of organic substances in the plant.**

The plant extracts from the soil mineral salts in solution and from the air  $\text{CO}_2$ , and separating and giving off the oxygen from the latter, bring the carbon in chemical contact with the element present in mineral salts, and through the presence of moisture favoring union complex molecules containing carbon, are constructed by a process of synthesis giving rise to the tartrates, citrates, malates, etc., of different metals (usually potassium, sodium or calcium).

**What elements enter into the animal system as necessary constituents?**

Potassium, sodium, calcium, magnesium, iron, oxygen, hydrogen, nitrogen, sulphur, phosphorus, chlorine, fluorine, carbon.

**Mention three groups of organic substances chiefly used as a food by animals.**

Proteids, fats and starches, and sugars (carbo-hydrates).

**State the most important substances found in coal tar.**

Benzene, toluene, naphthalene, anthracene, ammonia, aniline, pyridine, carbolic acid, acetic acid, etc.

**Describe the action of chlorine on alcohol.**

Chlorine may remove hydrogen from alcohol, or chlorine may replace hydrogen in the alcohol molecule.

**Describe the preparation and mention the properties of iodoform. Write the formula and state the chief uses of iodoform.**

Iodoform separates in crystals on cooling a hot solution of iodine, alcohol and potassium hydrate. Iodoform occurs in yellow hexagonal plates, smells of saffron, melts at  $120^{\circ}\text{C}$ , sublimes with but slight change, is insoluble in water, but dissolves in alcohol and ether. The formula of iodoform is  $\text{CHI}_3$ , and it is used as a local anesthetic, slight stimulant to granulating or ulcerous surfaces, absorbent of discharges, etc.; its solution in ether is less disagreeable in odor.

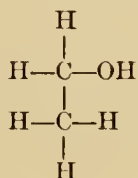
**Describe a method of preparing sulphuric ether. Mention the properties of sulphuric ether.**

A mixture of ethyl alcohol and sulphuric acid is heated at  $140^{\circ}\text{C}$  in a retort, the arising vapor of ether is received in a condenser, and alcohol in small quantity is allowed to continuously enter the retort.

Ether is a colorless, limpid, mobile liquid, of sharp burning taste, a characteristic odor, specific gravity of .723, boils at  $34.5^{\circ}\text{C}$ , slightly soluble in water, highly inflammable, and its vapor mixed with air is explosive.

**What is a graphic formula? Give an example.**

A graphic formula is a diagrammatic representation of the manner in which atoms or radicals unite to form molecules. Graphic formula of ethyl alcohol is



**State the source of each of the following acids: Citric, acetic, salicylic, oxalic.**

Citric acid is obtained from lemons.

Acetic acid from oxidation of alcohol.

Salicylic acid from wintergreen berries or coal tar.

Oxalic acid is obtained by heating sawdust and caustic potash, and treating the result successively with water, calcium hydrate and sulphuric acid.

**From what is cocaine derived? Mention the salt of cocaine that is chiefly used in surgery.**

From the leaves of the erythroxylon coca. The muriate or hydrochlorate of cocaine is used in surgery.

**Mention three chemical varieties of sugar and give their sources.**

Cane sugar (saccharum) from the sugar cane.

Milk sugar (lactose) from milk.

Glucose from fruit juices.

**Describe the dry process of refining gold.**

Remove iron or steel with a magnet. Place the impure gold in a boraxed crucible and melt under flux of potassic carbonate; add from time to time a mixture of potassic nitrate and anhydrous borax, stirring constantly, and when a sample, withdrawn from crucible and cooled, becomes freely malleable, pour the metallic contents of crucible into the ingot mould.

**State the effect of tin on an alloy of gold.**

A less proportion than 10% of tin in a gold alloy does not greatly impair the malleability of gold. It greatly lowers fusing point of gold. It overcomes tendency to expand when a gold alloy is used as filling. It diminishes conductivity.

**Write the formula of a standard three-metal alloy for amalgam fillings.**

Flagg's submarine dental amalgam alloy contains 35 parts tin, 60 parts silver, 5 parts copper.

**Write the formula of starch and mention the class of chemical compounds to which it belongs. State the reaction of the starch.**

Starch  $C_6H_{10}O_5$  belongs to that subdivision of the carbohydrate group known as the polysaccharids. Starch is neutral in reaction.

**State the forms in which arsenic occurs in nature. Describe a method of preparing  $As_2O_3$ .**

Arsenicum occurs in nature combined with sulphur as  $As_2S_3$  called orpiment, and  $As_2S_2$  called realgar; also exists in combination with nickel and iron, with cobalt and with a few other metals existing as arsenides.

$As_2O_3$  may be prepared by roasting any arsenical compound in air and condensing by cooling the resulting vapor of  $As_2O_3$ .

**Describe a test for  $CO_2$ .**

Pass the suspected gas into lime water, when, should it be  $CO_2$ , a deposit of calcium carbonate forms.

**Describe a method of precipitating platinum for its solution. State the color of the physical condition of the precipitate.**

Dissolve platinic dioxid  $PtO_2$  in dilute sulphuric acid; to this solution of platinum add an excess of ammonia, when a black precipitate of powdery black metallic platinum, known as fulminating platinum, is produced which detonates violently if heated to  $400^\circ F$ .

**State the source of bromine and the group of elements to which it belongs. Describe a method of preparing bromine.**

Mineral spring waters containing magnesian bromide, or sea water. Bromine is a member of the halogen group. It may be prepared by passing chlorine through a strong watery solution of a bromide and condensing the resulting vapor of bromine.



**Mention the principal ore of tin and describe the process of extracting metallic tin from the ore mentioned.**

Tin, stone or cassiterite,  $\text{SnO}_2$ , is the ore yielding tin. Tin is extracted from tin stone by washing latter till free from earthly impurities, then crushing, then washed to remove the light gangue, then roasted at low temperature driving off sulphur and arsenic, then exposed to air and moisture causing copper present to form copper sulphate, then washed with water to dissolve and remove the copper sulphate and all lighter oxids. This result known as black tin is then mixed with about 15% of fine anthracite coal and fused for several hours in a reverberatory furnace, when the metal separates and is ladeled into moulds.

**Define molecular weight. Give the molecular weight of each of the following:  $\text{Ag NO}_3$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{Na Cl}$ .**

The molecular weight of a compound is the sum of the atomic weights (or multiples of the atomic weights) of its constituents. The molecular weight of a gas is twice its density comparable with hydrogen.

Molecular weight of  $\text{AgNO}_3$  is 170.

Molecular weight of  $\text{H}_2\text{SO}_4$  is 98.

Molecular weight of  $\text{NaCl}$  is 58.5.

**Give the atomic weight and fusing point of argentum.**

Atomic weight of silver is 108; it fuses at  $1832^\circ \text{ F}$ .

## HISTOLOGY.

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### **By what tissues are nerve fibers held together?**

In the central nervous system, nerve fibers are held together by neuroglia. This consists of branched cells, connective tissue in function, though epiblastic in origin.

In peripheral nerves, the fibers and bundles of fibers are bound together by true connective tissue sheaths. That covering the nerve is called the epineurium; that surrounding the bundles of nerve fibers is the perineurium; uniting the fibers in the bundle are extensions from the perineurium, the endoneurium. These consist of bundles of ordinary connective tissue fibers.

### **What tissues are derived from the parablaster?**

The parablastic tissues include those usually spoken of as mesodermic, except the endothelial cells and the smooth muscle fibers (see page 352, Q. "What tissues are derived from the mesoblast?").

### **Mention the nourishing fluids of the body.**

The blood and the lymph.

### **Describe the blood platelets.**

These elements are very unstable when blood has been drawn, and therefore not easily demonstrated in the ordinary preparation. They occur, nevertheless, as round, flattened bodies. They are colorless and have an average diameter of one-third that of a red blood corpuscle. Their function though not definitely understood seems to be in relation with the phenomenon of coagulation of the blood.

**Describe a method of hardening tissues for microscopic sections.**

The tissues to be examined should be removed as freshly as possible from a recently killed animal and cut into pieces not more than two cm. in thickness. They should then be placed in a "fixative," such as absolute alcohol or Müller's fluid; the latter should be changed as soon as it becomes cloudy. Alcohol is more rapid in its action; small pieces can be fixed in a few hours, while Müller's fluid requires at least two weeks.

After fixation the tissues are hardened in increasing strengths of alcohol, beginning at eighty per cent, then ninety-five, and finally absolute alcohol. The tissue is now ready for infiltration with a suitable material which will give density, thus aiding in the cutting. Either paraffin or celloidin may be used.

The tissue must now be placed in a solvent of the substance used for infiltration. If celloidin be used, the solvent is equal parts of alcohol and ether. In this (A & E) the tissue should remain several hours (12-24), then in a solution of thin celloidin for an equal length of time. Following this the tissue is placed in thick celloidin, allowing it to remain for a sufficient length of time to permit an infiltration of the tissue with celloidin. It is finally mounted on a block, surrounding the tissue with a layer of thick celloidin which hardens when exposed to the air. The block and tissue should then be kept in eighty per cent. alcohol until ready for cutting.

**What is fibrin?**

As the name implies, it is a substance, fibrous in nature, which is formed during the process of coagulation of the blood. It is produced by the fibrin-forming principles, fibrinogen and fibrin ferment. Fibrin appears in the form of very delicate, interlacing, straight threads. These occupy a position between the blood corpuscles; sometimes they seem to radiate from a common center.

**State the function of cilia.**

Cilia occur upon surfaces in localities in which fluids are to be propelled or foreign bodies removed, e. g. mucous membrane of the respiratory tract.

**Describe the intercellular constituents of connective tissue. Describe one variety.**

These may be said to consist of two elements, fibers and the matrix. The fibers may be in the form of delicate, white connective tissue threads, formed probably at the expense of the cellular elements, placed parallel without anastomosis; or, the fibers may be yellow, highly refractile, anastomosing threads. The matrix of connective tissue gives to it its character, varying in density in the several tissues. In mucous or embryonic tissue it is colorless, transparent, gelatinous.

**Describe the microscopic appearance of pavement epithelium.**

This variety consists of a single layer of cells held together by a small amount of intercellular cement substance. When viewed from the surface it presents the appearance of a mosaic. The cells are usually squamous in shape.

**Define marginal zone.**

This term is applied to the striated border seen at the free margin of some cells, notably the epithelium in the small intestine.

**Describe the development of elastic fibrous tissue.**

In the elastic connective tissue the fibers are formed in the matrix, probably at the expense of the connective tissue cells. In the beginning, rows of chain-like arrangements of granules are seen. Subsequently, these granules become fused, forming branched elastic fibers.

**Describe Peyer's Patches.**

These are masses of small round cells (lymphoid) in a connective tissue reticulum, situated in the sub-mucous and

mucous coats of the lower part (ileum) of the small intestine. They are also known as agminate glands.

**Describe the process by which osteoblasts are converted into bone cells.**

Osteoblasts are the cells active in the production of osseous tissue. During the process the osteoblasts soon become enveloped in the bone matrix, occupying minute spaces—the lacunae. The cells, having ceased their action in the production of bone, become bone cells.

**Describe the structure of the mucous membrane lining the oral cavity.**

An epithelial covering, of the stratified squamous variety, and a connective tissue base form the essential structural elements. The outer layer of cells is flattened and scale-like; the deepest layer is of columnar cells, sometimes named the Malpighian layer; the intervening layers are of polyhedral cells. The connective tissue portion is the *tunica propria*, upon which rests the epithelium. It consists of somewhat densely arranged, while fibrous connective tissue in which are carried blood vessels, nerves and lymphatics. Projections of the tunica propria upward into the epithelium carry the terminal vessels and nerves. These projections are termed papillae and are best developed on the tongue and gums. Down-growths of the epithelium into the connective tissue are arranged in the form of sacs, clusters of which unite with a common duct. These are mucous glands, the ducts of which open on the surface of the mucous membrane. On the gums the epithelial layer of the mucous membrane is very thin. This accounts for the readiness with which the gums bleed. On the hard palate, the mucous membrane is thin and tightly adherent to the periosteum.

**State where marrow is found. Describe the varieties of marrow.**

Marrow is found in the interior of bone; in the medullary



canal in the shafts, and at the extremities of long bones; also in the interior of the flat and irregular bones. Variations in marrow are noticed in bones at different ages and also in different anatomical locations. In the cavities of long bones, in adult animals, the marrow is yellow, due to the accumulation of fat within it. The marrow of all bones in young animals is red, because of the great number of red blood corpuscles. The extremities of long bones (adult) also contain red marrow.

Red marrow consists of (a) marrow cells, or myelocytes, which resemble leucocytes, though larger, containing rather large nuclei. In the protoplasm of the cells are formed granules which stain with neutral stain, thus distinguishing them from mono-nuclear leucocytes. (b) Nucleated red blood corpuscles are formed in the marrow. They later lose their nuclei before entering into the circulation. (c) Cells, the protoplasm of which stains deeply with eosin; some of these cells are mono-nuclear, others are polymorpho-nuclear. (d) Leucocytes and lymphocytes. (e) Giant cells (myeloplaxes) which are large cells, polynuclear as a rule, and are the osteoclasts of bone development.

Yellow marrow contains few cells, an appreciable amount of areolar tissue containing fat.

**Describe the method of cutting tissues for microscopic section.**

Good sections may be cut by hand with a razor ground flat on one side, but the best result may be had by use of the microtome. For celloidin sections, the razor is arranged obliquely so that a long stroke may be made, using as much of the edge of the knife as is possible in cutting each section. The tissue block, held in a suitable clamp, is kept wet with eighty per cent. alcohol; the knife should also be kept flooded with alcohol, so that the sections can easily be straightened without tearing them.

For paraffine-embedded tissue, the sections are cut dry, and removed from the knife with a camel's-hair brush.

**Describe the cellular elements of connective tissue.**

The cells of connective tissue vary in shape with the variety and age of the tissue. The youngest cells occur in greatest number and more closely arranged than the older cells in the intercellular substance. Connective tissue cells may be round, oval, spindle-shaped, stellate; in the last instance they bear delicate protoplasmic prolongations, which interlace. In areolar tissue are found round and oval cells, fixed cells; wandering cells resembling leucocytes. Tendons contain flat cells arranged in lamellae between the bundles of fibers. Cartilage contains spindle and angulated cells, the latter being the older. Bone cells are irregular in shape. They have delicate processes which lie in canaliculi.

**Describe the microscopic appearance of columnar epithelium.**

Columnar epithelium may be simple or stratified. The cells are cylindrical in shape; the nucleus, usually oval, is situated at the base of the cell which rests on end upon the supporting membrane. When several layers of cells exist, it is only the superficial layer which has its cells distinctly columnar. The deeper cells are irregularly columnar or polyhedral. Columnar epithelium may or may not be ciliated.

**State how spongy bone is converted into compact bone.**

This is accomplished by the absorption of spongy bone, which thereby forms in it large oval spaces, the Haversian spaces, within which new formation of bone takes place. The bone cells deposit, layer by layer, new bone, until a narrow canal, the Haversian canal, remains instead of the former space.

**Describe fibro-cartilage.**

This variety consists of a hyaline matrix in which are embedded cartilage cells and fibers. The cells usually occur in groups of two or three in a lacuna, surrounded by a zone of clear matrix. Throughout the remainder of the matrix are

arranged delicate fibrils of white fibrous tissue. The transformation of hyaline cartilage into fibro-cartilage is well demonstrated at the attachment of the *ligamentum teres* to the head of the femur. Here the fibers of the ligament extend into the hyaline matrix of the articular cartilage. Fibro-cartilage is without a distinct perichondrium.

**Describe the development of cartilage.**

Cartilage grows from the inner or chondrogenic layer of the perichondrium which consists of spindle-shaped connective tissue cells. The cells produce the matrix, depositing it in layers beneath this membrane. As the cartilage grows, the cells remain in small spaces, lacinae, within the matrix, becoming larger and rounded as the age of the tissue advances. The youngest cartilage cells are spindle-shaped, arranged in rows immediately beneath the perichondrium.

**Describe the reticulum of lymphoid tissue.**

The reticulum of lymphoid tissue consists of an interlacement of bundles of white fibrous connective tissue, loosely arranged. Upon the bundles, particularly at their junctions, occur flattened or stellate connective-tissue cells. It is in this reticulum that the cells of the lymphoid tissue occur.

**Describe myxomatous tissue.**

This tissue is the youngest form of connective tissue. It consists of a jelly-like, transparent, homogeneous matrix in which are arranged stellate connective tissue cells, which have delicate protoplasmic prolongations. The branches frequently anastomose, forming a delicate reticulum.

**Describe Nasmyth's membrane.**

This structure is the remains of the enamel organ. As the tooth becomes larger the deepest layer of cells is forced toward the superficial layer. The intervening layers atrophy, and thus the enamel organ becomes reduced to a thin membrane which invests the crown of the tooth. This membrane per-

sists for a short time only after the tooth has been erupted, soon wearing away as the result of friction.

**Describe the microscopical appearance of adipose tissue.**

This tissue consists of a delicate reticulum of white fibrous connective tissue, containing comparatively large interstices in it. In the spaces are to be seen cells, the protoplasm of which has been displaced, the cell-wall distended and occupied by fat. The nucleus of the cell is pushed to one side, being displaced by the globule of fat. The fat cells are usually in groups surrounded by areolar tissue; a rich blood supply is found in this tissue.

**Give the microscopic appearance of non-medullated nerve fiber.**

Such a nerve fiber is distinguished from the medullated nerve fiber by the absence of the medullary sheath. It consists of an axis cylinder and a neurilemma; the fibers branch freely previous to their termination, which is not true of medullated nerve fibers. The axis-cylinder is distinctly fibrillated. Nuclei are numerous, being irregularly placed along the course of the fiber, lying beneath the neurilemma.

**What are lacunae?**

Lacunæ are spaces found in compact connective tissue, such as cartilage and bone (cementum). They contain the cells of the particular tissue and also lymph. In bone they communicate with one another by means of minute capillary-like channels, called canaliculi.

**Describe the structures composing the heart.**

*Pericardium*, which covers the heart and forms a closed sac is a serous membrane, consisting of a single layer of endothelial cells, resting upon a basement membrane of fibro-elastic connective tissue.

The *myocardium*, or the muscular tissue of the heart, forms the bulk of the organ. It consists of a dense network of branching muscle fibers nucleated and without a sarco-

lemma. The fibers are short, cylindrical in shape, grouped together in bundles, united by connective tissue. On the surface of the muscle the connective tissue blends with that of the pericardium.

The *endocardium*, the lining of the heart cavities, is a serous membrane, with a single layer of endothelial cells resting on a connective tissue base. It is continuous with the intima of the blood-vessels. At the orifices of the heart chambers the endocardium presents reduplications, to form the heart valves, which are reënforced with bands of fibrous connective tissue.

### **Mention the tissues derived from the hypoblast.**

The epithelium of the digestive tract and the associated glands, except the oral cavity and its glands; the epithelium of the respiratory tract; urinary bladder and the urethra; ureters; epithelium of the thyroid body and thymus (Hassal's corpuscles); Eustachian tube and middle ear.

### **Give the location of stratified epithelium.**

Squamous:

Oral cavity—pharynx, esophagus, epiglottis—true and false vocal cords, epidermis, cornea, external auditory canal, vagina, female urethra, beginning and end of male urethra, urinary bladder, ureters, pelves of the kidneys (transitional epithelium).

Columnar (non-ciliated).

Olfactory, part of the nasal fossæ, part of vas-deferens.

Columnar (ciliated):

Eustachian tube, part of tympanic cavity, lachrymal passage, respiratory part of nasal fossæ, ventricle of larynx, trachea and bronchi, epididymis and the first part of the vas-deferens.

### **How do nerve fibers terminate?**

Before reaching its termination a nerve fiber loses its myelin sheath; next, its neurilemma, and continues for a



short distance as a naked axis-cylinder; these break up into fibrillæ and terminate as general free endings.

Nerves may also end in special nerve-endings, as in tactile cells or tactile corpuscles or end bulbs.

Motor endings in muscle are in the form of inter-muscular plexuses, which ultimately become naked axis-cylinders, and these in turn break up into fibrillæ and terminate in motor end plates.

**Describe the perforating fibers of Sharpey.**

These are transversely placed fibers occurring in the superficial lamellæ of bone and represent extensions of periosteum which have not undergone calcification.

They are found most numerous in spongy bone and in the interstitial lamellæ of compact bone.

**Describe the centers of ossification.**

In the development of bone, particularly enchondronal bone, are found areas in which the first changes in the bone-forming process take place. These areas are the so-called centers of ossification.

The cartilage cells multiply and increase in size, becoming separated from one another by an increase in the intercellular substance and finally are arranged in vertical rows. It is here that the first deposition of calcareous substance takes place, and is known as the "primary areola of Sharpey."

- (a) What are giant cells? (b) Give their function.  
(c) What will cause their action to cease?

(a) Giant cells are large, multi-nuclear cells found in bone marrow. (See answer to question, "Describe varieties of marrow," page 344).

(b) Their function is that of bone resorption.

(c) Isolation by osseous tissue will cause their action to cease.

**Describe the ossification of the alveolar process.**

Before birth, the alveolar process presents on its superior

margin a deep longitudinal furrow which corresponds to the future tooth-sockets, and in which are contained the developing temporary teeth. Later, the walls of the process are built up, so as to surround the root of each tooth with a bony wall. This same wall is resorbed with the roots of the temporary teeth when they are shed. For the permanent teeth the process is rebuilt as before.

**What tissues of the teeth are developed from the connective tissue group?**

Dentine, cementum, pulp and its vessels.

**What are the Striae of Retzius?**

The stripes of Retzius are dark lines in the enamel passing in a direction generally parallel to the surface of the enamel. These are due, no doubt, to inequalities in development, and also in density of its substances.

**Describe the Stratum Malpighii.**

This is the deepest layer of cells of the oral epithelium, which comprises the active portion of the enamel organ. It consists of columnar- and polyhedral-shaped cells.

**Describe the blood supply to the tooth pulp and pericementum.**

The arterial twigs enter the pulp-canal by the apical foramen and break up into a plexus of capillaries arranged densely at the periphery beneath the layer of odontoblasts. From the same artery branches extend upwards into the pericementum; branches are again distributed laterally in the pericementum, some of which pass for a short distance into the cementum and the adjacent alveolar wall.

**What is cartilage?**

Cartilage is a dense variety of connective tissue. It is more or less translucent, containing in the matrix a principle known as chondrin, which gives density, and to a degree elasticity, to the cartilage. Cartilage occurs at the articular

surfaces of all long bones; between the articulations of some bones; the costal cartilage; external ear; and in the embryo—the entire skeleton, except the bones of the face and cranium, and part of the inferior maxilla.

**Name the three organs which effect the calcification of the tooth.**

The ameloblasts of the enamel organ, the odontoblasts of the dentinal papilla, and the cementoblasts of the alveolar periosteum.

**Describe a transverse section of the root of a tooth, as seen under the microscope.**

In the interior of the root will be seen an opening; this corresponds to the lumen of the pulp-canal. Whether or not the pulp will be seen will depend upon the method of preparation of the specimen. Dried specimens are best for examining the structure of the bulk of a tooth, in which preparation the pulp will not be demonstrable. On the periphery will be seen a zone of osseous tissue, the cementum; the exterior of this may or may not show the remains of the periodontal membrane. Internal to the cementum lies the dentine, the tubules of which arranged radially extend from the pulp-canal as a center.

**With what do the dentinal tubules connect at their inner extremities?**

The pulp-chamber.

**What tissues of the oral cavity are formed from the epiblastic layer? From the mesoblastic layer?**

From the epiblast are developed the epithelium of the mouth, including its glands, the enamel organ, and nerves.

From the mesoblast are developed the tunica propria of the mucous membrane, its blood-vessels and lymphatics, muscle fibers, dental papillæ and their products.

**Where are the lines of Schreger found? (b) Salter?**

(a) Schreger's lines occur throughout the dentine.

(b) Salter's incremental lines are found in the outer layer of dentine.

**Name the different kinds of cells found in the alveolo-dental membrane.**

This membrane contains, as does other connective tissue, spindle-shaped connective tissue cells. In addition, it contains special cells. The cementoblasts for the production of cementum; the cementoclasts, for resorption.

**With what do the dentinal fibrils connect?**

The odontoblasts.

**What is the purpose of secondary dentine? How does it differ from true dentine?**

Secondary dentine, when formed in carious teeth, serves to supply the loss sustained by the weakening of the wall. Secondary dentine is frequently found in the teeth of old persons without caries. This is due to stimulation of the odontoblasts by some irritant.

Secondary dentine differs from true dentine in the fact that it is usually irregularly and imperfectly calcified. It is also known as osteo-dentine.

**What form of epithelium lines the oral cavity? From what elementary tissue is it developed?**

Stratified squamous; developed from the epiblast.

**State the various cell layers of the completed enamel organ. Give their relative position.**

The layer of ameloblasts which forms the deepest layer lies adjacent to the dental papilla; the stellate reticulum, or layer of polyhedral cells, which occupy the interior of the enamel organ; the superficial epithelial layer, which is a direct continuation of the oral epithelium; between the superficial stra-

tum and the stellate reticulum lies the "stratum intermedium."

**Where does calcification first appear in a developing tooth, and what size and shape is the dentinal germ?**

"Calcification of dentin begins on the coronal extremities of the crowns. The dentinal germ is the same size and shape as the crown of the future tooth."

**Describe the different tissues of the teeth and give their location?**

Enamel, dentine, cementum and pulp. The enamel covers the crown of the tooth, dentine forms the body of the tooth and is intermediate in position between the enamel and pulp; the pulp occupies the central chamber of the tooth and the cementum covers the roots of the teeth.

**How do the arterial vessels in the pulp differ from those just outside of the apical foramen?**

The arterial vessels in the pulp are found as a capillary network, composed of a layer of endothelial cells, while those outside of the foramen are much larger, consisting of two coats.

**With what is the surface of the gum covered?**

Mucous membrane.

**What is the function of the peridental membrane and how does it receive its blood supply?**

The function of the peridental membrane is to hold the tooth in its socket, give sense of touch to the tooth, act as a cushion to receive shock due to mastication, to nourish the tooth when the pulp is devitalized and to nourish the cementum of the tooth. It receives its blood supply from the same arterial branch as the tooth, this branch giving off several twigs before entering the apical foramen.



**What is the structural difference between an artery and a vein?**

Veins have, on the whole, much thinner walls than arteries in proportion to the calibre of the vessels. The endothelial cells of veins are broader and shorter than in arteries. Veins contain less muscle but more connective tissue than arteries.

**Describe fully the white corpuscles of the blood and give their origin.**

The white corpuscles at rest are globular nucleated masses of protoplasm about  $\frac{1}{2500}$  of an inch in diameter. There are a number of varieties. The small mononuclear or lymphocyte, the large mononuclear or transitional, the polymorphonuclear, which is the most abundant, and the eosinophile containing coarse granules readily stained with eosin.

The leucocytes have the power to throw out pseudopodia, or, as it is called, amoeboid movement. They originate in the lymphatic tissue and in the marrow of bones.

**How is secondary dentine formed?**

By the odontoblasts being stimulated into activity by irritation of the pulp. It is most frequently caused by the advance of the caries.

**How is cellular activity stimulated in the resorption of the roots of deciduous teeth?**

By the vascular papilla and probably by the pressure caused by the advance of the permanent teeth.

**How and from what source does a tooth receive its blood supply?**

By means of the pulp and pericemental membrane; from the inferior dental to the inferior teeth, and from the alveolar and infra-orbital to the upper teeth.

**Describe the natural means by which the deciduous teeth are shed.**

The resorption begins at the apical extremities of the root

and gradually progresses towards the crown. It is brought about by the agency of the osteoclasts; resorption taking place in the order of eruption contained in vascular papillæ.

**Describe the dental tubuli.**

The dental tubuli are small wave-like canals which run from the periphery of the pulp in a perpendicular direction to the surface. They vary in size from 1.1 to 2.3 microns. They anastomose freely.

**Describe an odontoblast.**

They are large, elongated, multipolar, nucleated cells. Before dentinification they are spheroid. During this process their extremities become somewhat flattened and square.

**What tissue is developed from the outer layer of cells, and what of the inner layer of the follicular sac?**

From the outer, the peridental membrane is developed and from the inner layer the cementum is developed.

**From what sources do the different structures of a tooth receive their nourishment?**

The enamel, from the dentine; dentine, through the pulp; pulp, from its vascular supply; cementum, from the peridental membrane.

**What is spongioplasm?**

Spongioplasm is a part of the protoplasm of a cell. It is a very delicate network which supports the fluid portion of the protoplasm.

**What is the nucleus of a cell?**

The nucleus is usually a round or oval body situated in the interior of the cell body. It consists, like the protoplasm, of two parts: (1) The chromatin, having, as the name implies, a great affinity for stains; it is arranged in the form of a delicate reticulum. (2) The achromatin, a clear semi-fluid substance, staining feebly, if at all, and occupying the meshes of the chromatin. Within the nucleus may be seen

one or more smaller rounded bodies—the nucleoli. The nucleus is in many instances limited by a distinct nuclear membrane.

**What is the nuclear matrix?**

The nuclear matrix is the inter-fibrillar substance of the nucleus. A clear semi-fluid, homogeneous substance.

**Is dentine developed inwardly or outwardly?**

Dentine develops from without toward the papilla.

**In what manner does dentine increase?**

By a gradual deposit by the odontoblasts, of layers of a substance which later becomes calcified.

**What would be the result of exposing dentine to the action of a strong acid for several days?**

The earthy substance would be removed and a substance yielding gelatin would remain.

**What is the structure of human enamel?**

Enamel is an exceedingly hard substance. It is composed of elements prismatic in shape, usually six-sided, placed vertically to the dentine, are united by a cement substance. It exhibits parallel stripes representing strata of lime salts deposited, called the stripes of Retzius.

**Give the varieties of connective tissue.**

White fibrous. Yellow elastic. Areolar and modifications: adipose and adenoid. Mucous or embryonic. Cartilage. Bone. Dentine.

**Give the analysis of cementum.**

Cementum has a composition like that of bone. Of organic matter, there is about 33%. The remainder consists of inorganic substance in the form of the phosphates of lime and magnesium, carbonate of lime, sodium chloride and calcium fluoride.

**What is an organic tissue?**

An organic tissue is one in which the structural elements are chiefly, if not entirely, composed of living organized substances.

**Define lymphatics. Are lymphatics found in the teeth?**

Lymphatics are vessels, with exceedingly delicate walls, the function of which is to take up the excess of nutrient fluids that have been poured from the capillaries for the nourishment of the tissues, and return it to the blood stream. They also carry the nutrient fluids from the digestive canal. No distinct lymphatics have been demonstrated in the teeth.

**What is hemoglobin?**

The coloring matter of the red blood cell, which, when separated from the blood, crystallizes into the form of elongated prisms. It is a proteid substance having a great affinity for oxygen.

**State the kinds of nerve fibers.**

Medullated, or white fibers; non-medullated, gray, or Remak's fibers.

**Describe the secondary dentine.**

Late in life the pulp cavity becomes more or less filled with a dense substance, the structure of which is intermediate between dentine and bone. It is a secondary dentine, also called osteo-dentine.

**Describe a ganglion.**

Ganglia are bulbous structures situated on the posterior nerve roots of the spinal cord, on some of the cranial nerves and in the sympathetic system. They consist of a collection of nerve cells, each being enclosed in a capsule which is continuous with the sheath of the fiber communicating with it. The cells are enclosed in a reticulum of connective tissue which also contain additional nerve fibers not connected with the cell.

**From what germ layers is epithelium developed?**

Epithelium is developed from the ectoderm, entoderm and mesoderm.

**What is histology?**

The term histology is derived from the Greek "histos," a web or tissue, and "logos," a treatise. It is that part of science which has for its object the study of tissues.

**What is protoplasm?**

Protoplasm is a proteid substance, containing, in addition, some inorganic substances, viz.: phosphorus, calcium. Structurally it consists of a reticulum, the spongioplasm, in the meshes of which is contained a clear semi-fluid substance, the hyaloplasm.

**What is a cell?**

A cell is a structural element. It consists of a nucleated mass of protoplasm endowed with the properties of life—growth, metabolism, reproduction, motion and irritability.

**What is the peridental membrane?**

It is that part of the alveolar periosteum which is reduplicated upon the root of the tooth for the purpose of binding the tooth in the socket, producing the cementum, and of supporting blood-vessels.

**Give analysis of dentine and enamel.**

Dentine contains about 28% of animal matter and 72% of earthy matter. Enamel contains but about 4% of animal matter. The earthy matter in both consists of the phosphates of calcium and magnesium, carbonate and fluoride of calcium.

**What is a tooth germ?**

The structure consisting of embryonal tissues from which the tooth is developed.

**How is bone developed?**

(1) In cartilage, where the substitution of calcified sub-



stance is effected by the osteoblasts. (2) In fibrous tissue, by the deposit of calcified substance upon the bundles of fibrous tissue. (3) From the periosteum, by an ingrowth of periosteal buds. This variety also substitutes cartilage, but differs from the enchondronal in that it grows from the surface.

### **What is epithelium?**

Epithelium is an elementary tissue found covering surfaces and lining cavities. The cellular element exceeds the intercellular in amount, the latter consisting of but a small quantity of intercellular cement substance.

**Of what is each of the following composed: (a) the hair, (b) the nails, (c) the enamel of the teeth?**

The hair is a modification of the epithelium of the epidermis; the nails are a very highly developed part of the stratum lucidum of the epidermis. The enamel of the teeth is a product of the epithelium of the oral cavity.

### **Describe the Haversian system.**

A Haversian system occurs in compact bone and consists of a system of channels through which the nutrient fluids pass. It consists of the following: a centrally placed canal, the Haversian canal, which is surrounded by concentric layers or plates of bone, the lamellæ. Between the plates of bone are irregular clefts, the lacunæ, which communicate with each other and with the Haversian canal by means of radially placed canals—the canaliculi.

**What is periosteum? Of what tissues is it formed?**

A membrane which, as its name indicates, invests the bone for the purpose of supporting the blood-vessels, and also to take part in the growth of bone. It consists of two layers: (1) an outer, composed of white fibrous tissue, containing numerous blood-vessels; (2) the inner, or osteogenetic layer, which is rich in elastic fibers and spindle-shaped cells—osteogenetic cells.

**Describe the formation of the teeth.**

The teeth are composed of three substances—the enamel, the dentine and the cementum. The enamel covers the exposed part of the tooth, the crown of the tooth. The cementum covers the part of the tooth within the alveolus of the jaw. The junction of the enamel with the cementum is called the neck of the tooth. The bulk of the tooth is made up of the dentine, which extends from the root to the crown. Each tooth contains a cavity, the pulp cavity, which communicates with the exterior through a small aperture at the apex of the root, the apical foramen. The cavity contains a soft connective tissue—the pulp, rich in vessels and nerves. The fang, or root of the tooth has a fibrous investment called the peridental membrane, or periosteum.

**What is an odontoblast?**

An odontoblast is a modified and specialized connective tissue cell, for the production of dentine.

**Where are nerve cells found? Describe their structure and functions.**

Nerve cells exist in the gray matter of the cerebrum, cerebellum, spinal cord and the posterior nerve root ganglia, in the sympathetic nervous system, and in the medullary portion of the supra-renal capsules, according to some authorities. A nerve cell consists of a cell body—a large nucleated mass of protoplasm having prolongations or poles, and usually containing a nucleolus. Nerve cells are classified according to the number of processes, as unipolar, bipolar and multipolar. Each nerve cell is the point at which a nerve fiber originates in one of the protoplasmic processes, known as the AXIS CYLINDER PROCESS. The other processes when present are branched, therefore are called dendrites. The function of nerve cells is to generate nervous impulses.

**Describe the structure of a salivary gland.**

A salivary gland is a tubulo-racemose gland. It is in-

vested with a fibrous tissue capsule which sends trabeculae into the substance of the gland to divide it into lobes; these in turn are subdivided into lobules. Each lobule consists of a collection of secreting units, the acini, which are composed of glandular epithelium resting upon a basement membrane. The secretion leaves the gland through its ducts, named according to their position in the gland. The interlobular ducts between the lobules, the intralobular ducts within the lobules, and the intermediate ducts leading from the acini to the intralobular ducts. Acini may be of the serous type, the cells of which are granular and stain deeply; or mucous, the cells being clear and staining faintly.

**What tooth germ first appears and at what period?**

Of the temporary teeth, the germ for the first molar appears in the sixth week of embryonic life.

**Is dentine vascular? Explain.**

Dentine does not contain blood-vessels. It probably receives its nourishment indirectly from the vessels of the pulp as does the true bone by means of its canaliculi.

**What is connective tissue?**

A tissue of mesodermic origin which is composed of a cellular and intercellular substance, the latter being predominant. The cells vary in shape, being round, spindle-shaped, stellate and fusiform. The intercellular substance consists of fibres and a matrix which vary in their characteristics in various kinds of connective tissue.

**Where does cementum form the thickest?**

At the apex of the fang of the tooth.

**Mention the structures contained in a cell.**

A typical cell contains a cell wall or membrane, cell contents or protoplasm, nuclear membrane, nucleus, nucleolus. Some cells contain merely the protoplasm and the nucleus.

**What are the primary germ layers?**

The ectoderm or epiblast, mesoderm or mesoblast, entoderm or hypoblast.

**Describe (a) mucous tissue, (b) white fibrous tissue, (c) elastic tissue.**

(a) Mucous tissue is a transparent, jelly-like tissue. Microscopically it is composed of stellate cells arranged in a homogeneous semi-fluid matrix.

(b) White fibrous tissue consists of delicate white fibers. It may be dense, as in tendons, or loose, as in areolar tissue. The fibers do not branch. On boiling fibrous tissue it yields gelatin.

(c) Elastic tissue consists of yellow, highly refractile fibers which branch freely and have a great tendency to curl at the free ends. The fibers are very elastic, and when boiled yield elastin.

**Describe two kinds of bone development.**

In *enchondronal* bone, hyaline cartilage becomes transformed into osseous tissue. First the cartilage cells multiply and become arranged in vertical rows, particularly at the epiphyses, and the substance between the cells becomes the seat of a deposit of lime salts. In order that the marrow cavity and the Haversian canals or spaces be formed, certain cells called *osteoclasts* absorb some of the osseous tissue. In long bones, ossification also takes place from the periosteum by periosteal buds growing into the cartilage.

*Intra-membranous* bone develops in fibrous tissue. The bundles of fibres become calcified by the deposit of lime salts upon them by the osteoblasts. This usually takes place in a manner radiating from a center of ossification.

**Describe osteoblast, osteoclast.**

An osteoblast is a bone-making connective tissue cell. An osteoclast is a cell which absorbs the calcified substance of bony structures.

**State the difference between compact bone and spongy bone.**

Compact bone is densely made up, being composed of layers of calcified matrix, called lamellæ. It contains Haversian canals, with concentric lamellæ, between the Haversian systems—interstitial lamellæ; lamellæ concentric with the periphery of the bone; and, if a long bone, perimedullary lamellæ. Spongy bone is loosely constructed, being composed of an interlacement of calcified septa forming spaces called Haversian spaces.

**What tissue binds together the voluntary muscle fibers?**

Extensions from the connective tissue covering of the muscles, called the endomysium.

**What is the sarcolemma?**

The delicate sheath investing the muscle fiber of striated voluntary muscle.

**Define neuro-epithelium and state where it is found?**

Neuro-epithelium is of ectodermic origin, and consists of modified epithelial cells situated at the *terminal of nerves of special sense* for the purpose of receiving impulses.

**Describe the axis cylinder, the medullary substance, the neurilemma.**

These are parts of a so-called medullated nerve fibre. The axis cylinder is the essential part; it begins at the origin of the nerve fiber in the cell and continues to the termination of the fiber. It occupies a central position in the fiber and appears to be made up of delicate fibrillæ, the primitive fibrillæ. It is said to have a delicate sheath, the axilemma. The medullary substance is the substance which invests the axis cylinder of medullated fibers. It is known as the "white substance of Schwann." It is of a fatty nature and is regarded as serving to insulate the axis cylinder. It is not continuous, being interrupted at points called the "nodes of Ranvier." The neurilemma is the primitive sheath forming the



covering of the nerve fiber. It is a structureless, transparent membrane beneath which are situated nuclei, surrounded by a small amount of protoplasm forming the nerve corpuscles.

**From what layer of the embryo is the vascular system developed?**

From the mesoderm.

**Where does calcification of a tooth begin?**

Calcification of the enamel begins at that part nearest the papilla. In the dentine, it begins at the periphery of the papilla.

**What tissues are derived from the mesoblast?**

All forms of connective tissue, muscular tissue, endothelium of the blood and lymph vessels, pericardium, endocardium, pleura, peritoneum, spleen, kidney and ureter, testicle and ducts, ovary and Fallopian tubes, uterus and vagina.

**Describe the cellular elements and the fluid portion of the blood.**

The cellular elements of the blood are the erythrocytes, or red blood-cells, and the leucocytes, or white blood-cells. The fluid portion is the plasma, or liquor sanguinis, in which the cells are suspended. The red blood-cells are of a greenish-yellow cast, but when massed together give the red appearance to the blood. In distinction to the white blood-cells, they are not nucleated as the latter are. They occur in the proportion of 500 red to 1 white. White blood corpuscles have the power of amoeboid motion. There are several varieties of leucocytes named according to the character of the nucleus and affinity for stains. The most important are the polynuclear leucocytes occurring in about 70% of all the leucocytes. The fluid part of the blood is a somewhat sticky, clammy liquid. It contains the factors of fibrin, namely, fibrinogen and fibrin ferment, which are the agencies active in the clotting of blood.

**Describe the dental ridge.**

It consists of a linear thickening of the primitive oral epithelium from which the enamel germ is later formed.

**What layers of the embryo contribute to the development of the teeth?**

The ectoderm and the mesoderm.

**Which of the permanent teeth first calcify?**

The first molars (sixth month) in the upper jaw. A little later in the lower jaw.

**What is the origin of the cementum?**

Cementum has its derivation in the alveolar periosteum.

**What is a phagocyte?**

It is a cell possessing the power of amoeboid movement, by means of which it takes in and incorporates particles with its own substance. It is usually a leucocyte.

**What are leucocytes?**

The colorless corpuseles of the blood, usually known as white corpuseles.

**How many kinds of bone tissue are there?**

Bone is usually divided into two varieties: (1) compact or dense, and (2) cancellated or spongy.

**What is tissue?**

Tissue is an arrangement of structural elements and consists of a cellular and an intercellular substance. When the structural elements are of the same type, it is known as a simple or elementary tissue; when of more than one type, it is a complex tissue.

**What is the blastoderm?**

The blastoderm is a sac-like arrangement of embryonal cells formed by the cleavage of the ovum. It consists of three layers: ectoderm, mesoderm and entoderm; from these all of the tissues of the animal body are developed.

**How do cells receive their nourishment?**

Cells are nourished by means of the nutrient blood plasma which escapes from the walls of the ultimate capillaries in the tissue. The cells are literally bathed in the blood plasma.

**What is embryology?**

That part of science which treats of the development of the embryo is known as embryology.

**Describe the development of blood vessels and lymphatics.**

Having a mesodermic origin, the blood and lymph vessels first appear as "cords" of cells which later become hollow to form tubes. The innermost cells become distinctly flattened to form the endothelial lining. The first blood-vessels have their beginning outside the body of the embryo, in the yolk-sac.

**Describe the muscular tissue.**

Muscular tissue is of mesodermic origin and consists principally of elongated cells (fibrous cells) which have the inherent power of contracting. The muscle fibers contain nuclei and, sometimes, that which corresponds to a cell wall, the sarcolemma. Voluntary and cardiac muscles are striated, due to the arrangement of alternate light and dark discs. Non-striated muscle is involuntary. Microscopically, they may be differentiated as follows:

<b>Striated.</b>	<b>Non-Striated.</b>	<b>Cardiac.</b>
Fibers striated transversely.	No striations.	Striated longitudinally and transversely.
Has sarcolemma.	Hyaline sheath.	No sarcolemma.
Nucleus beneath sarcolemma.	Nucleus in center.	Nucleus oval and in center.
Fibers do not branch, except in the tongue.		Fibers short. Fibers branch freely.

**To what class of tissues do the teeth belong?**

With the exception of the enamel, which is a product of epithelium, the teeth belong to the connective-tissue group.

**From what is the six-year molar derived?**

The enamel germ of the first permanent molar appears at the extremity of the dental ridge after the manner of a temporary tooth; it appears about a week before the budding of the germs of the temporary teeth.

**Give the principal tissues of the animal body.**

Blood and lymph, epithelium, connective, muscular and nervous. The blood and lymph are often classified with the connective tissue.

**State the functions of epithelium.**

Protective, secretory, absorptive, to permit exchange of gases, to produce motion (ciliary), for the reduction of friction (endothelium), and for the reception of nervous impulses.

**What are the soft fibers of Tomes?**

Prolongations of the odontoblasts into the dentinal tubules are known as "fibers of Tomes."

**State the size, shape and structure of a human red blood corpuscle.**

The red blood corpuscles are disc-shaped, biconcave, and are 1-3200 of an inch in diameter. They are not nucleated; and, though they probably have a delicate cell wall, none can be demonstrated. The cell contains a substance, hemoglobin, which gives the color to the cell.

**Describe the structure of arteries.**

The medium-sized arteries are composed of three coats or tunics. *The tunica intima* (inner), consisting of an endothelial lining, resting upon a sub-endothelial layer of loose connective tissue, which is separated from the middle coat by a layer of elastic tissue, *lamina elastica interna*. *The tunica media* (middle) is a muscular tunic and consists of a layer of

involuntary (non-striated) muscle fibers circularly arranged. The *tunica adventitia* (outer) consists of an admixture of white fibrous and yellow elastic connective tissues. This tunic contains small vessels which nourish the artery, called *vasa vasorum*.

**To what tissue does dentine belong?**

To the connective tissue of the dense variety.

**What is bioplasm?**

The living substance of the cell. The term is often used synonymously with protoplasm.

**Mention the varieties of epithelium.**

Squamous, columnar, ciliated, glandular, transitional, pigmented, and neuro-epithelium. The first three may occur in a single layer, when it is named "simple;" or, in several layers, when it is called "stratified."

**Describe the more minute structures which evolve the sense of taste.**

On the dorsum and sides of the tongue, particularly the former, are elevations of the mucous membrane in the form of papillæ.

A few of the papillæ (8-12), situated on the posterior part of the dorsum of the tongue, are surrounded by a furrow, hence called the circumvallate papillæ. They are arranged in the form of the letter "V," the apex being directed posteriorly. These papillæ usually bear secondary papillæ. Embedded in the stratified squamous epithelium on the surface of the papillæ are oval bodies composed of modified epithelial cells arranged "like the staves of a barrel." These are the taste buds which are communicant with the terminals of the gustatory nerve.

The fungiform papillæ, more numerous than the circumvallate, receive filaments of the nerves of taste; but there are fewer of the "special endings" than in the circumvallate. Secondary papillæ also occur on the fungiform papillæ.



The largest number of the papillæ is of the conical or filiform variety, consisting of a conical elevation of connective tissue covered with epithelium. They carry the terminals of the nerve fibres to the periphery.

**Describe the cell structure of articular cartilage.**

The articular surfaces are covered with hyaline cartilage, the distinguishing feature of which is the translucency of its matrix. The matrix, which presents a homogeneous appearance, contains many cartilage cells which occupy and completely fill spaces called lacunæ. Sometimes, two or more cells occur in a single lacuna. The cells are distinctly nucleated; the youngest are spindle-shaped and occupy a position next to the perichondrium, while the oldest cells are deeper and are irregularly rounded, having a tendency to become angulated.

**How does a mucous membrane differ from a serous membrane?**

Mucous membranes line all cavities communicating directly or indirectly with the atmosphere. They consist of an epithelial covering, the variety of which varies with the location, resting upon a connective tissue base—the *tunica propria*. Extensions of the epithelium into the connective tissue beneath, arranged in the form of tubes or sacs (usually the latter) which secrete mucous for the purpose of moistening the surface of the membrane, form the mucous glands.

Serous membranes are found lining closed sacs. They consist of a single layer of endothelial cells resting upon a connective tissue membrane. Minute openings, stomata, existing between some of the cells, communicate with lymph capillaries. The fluid found on the surface of serous membranes comes from the lymph channels. Serous sacs may be regarded as large lymph spaces.

**Describe the pericemental membrane. Give its origin and function.**

The pericemental membrane is the fibrous tissue investment

which covers the root of the tooth. The fibres composing it run, for the most part, transversely. Elastic fibres are notably absent. It has its origin in the outer layer of the dental sac. This membrane serves to hold the tooth in the alveolus and to furnish the nutrition to the cementum through the blood-vessels it carries. Acting as a cushion, it seems to diminish shock during mastication.

**Differentiate between osteoclasts and cementoblasts.**

Osteoclasts are connective tissue cells found in bone-forming tissue. It is by their agency, the absorption of calcified matrix, that the Haversian canals and spaces are formed.

Cementoblasts are also connective tissue cells, but their function is that of depositing lime salts in the matrix of the cementum.

**Describe the process of dental calcification.**

At about the end of the fourth month the enamel of the temporary teeth is formed. From the extremity of the enamel cells, next to the papillæ, develops a tuft-like projection, which becomes calcified, forming an enamel prism. The process of calcification proceeds, therefore, from within outward.

At about the same period the deposit of dentine on the sides and apex of the dental papillæ begins, and therefore proceeds from without inward. Calcification of the dentine is not complete, for the areas known as interglobular spaces are not calcified, nor are the processes of the odontoblasts—the dentinal fibres.

**Describe the structure, blood supply and nerves of the pulp.**

The pulp consists of embryonic connective tissue which is composed of stellate cells arranged in a semifluid, transparent matrix.

Next to the wall of the pulp-canal are columnar-shaped cells, the odontoblasts, processes of which enter the dentine as the dentinal fibrils.

The pulp is well supplied with blood-vessels and nerves

which enter at the apical foramen. After entering the pulp-anal they break up to form plexuses which terminate in the layer of odontoblasts.

The function of the pulp is that of furnishing nutrition to the dentine and enamel. Due to the rich nerve supply, the pulp is very sensitive.

**From what is the mesoblast derived?**

The mesoblast has its origin partly in the epiblast and partly in the hypoblast, though chiefly the latter.

**What two tissues are formed by the dental papilla?**

The dentine which is deposited at the periphery of the papilla; and the pulp, which is that portion of the papilla remaining after dentine has been formed.

**Describe separately the calcified products of the connective tissue.**

Bone may be considered to be of two kinds: compact or dense, and cancellated or spongy.

Compact bone consists of a dense matrix containing lime salts, which matrix contains numerous channels for the passage of nutrient vessels and fluids, also clefts or spaces, containing bone cells. The largest channels (1-500 inch in diameter), called "Haversian Canals," run parallel with the long axis of the bone and form anastomoses with one another. The canals are surrounded with concentric layers of osseous matrix: *Haversian lamellæ*, between which are small spaces, the *lacunæ*, which in recent bone contain bone cells. Radiating from the Haversian canals to the lacunæ, are minute channels which convey lymph. They are the *canaliculi*. The above-named structures form what is termed a "Haversian System." Between the systems, which are circular, *interstitial lamellæ* occur, thus filling the space that otherwise would exist.

Lamellæ also occur concentrically with the periphery of the shaft of the bone, the *circumferential lamellæ*, and with the medullary canal, the *perimedullary lamellæ*.

Spongy bone does not contain Haversian systems, and, therefore, no Haversian canals. There are, however, as the name implies, numerous spaces in the matrix; they are known as "Haversian spaces."

Dentine consists of a calcified matrix in which, extending through the entire thickness of the matrix, are seen the dentinal tubules which terminate in irregular clefts at the junction of the dentine with the enamel and cementum. These clefts are known as the *interglobular spaces*. The part of the matrix immediately surrounding the tubules forms the dentinal sheaths. The tubules contain processes of cells at the periphery of the dentine—the *dentinal fibres*.

Cementum resembles very closely the structure of bone. Near the apex of the root, where the cementum is thickest, Haversian canals may sometimes exist, though usually they are not present.

**What tissue is the origin of the enamel? What are ameloblasts?**

Enamel originates in the oral epithelium.

Ameloblasts are the enamel-producing cells. They are distinctly columnar in shape and occupy a position in the enamel organ nearest the dentine.

**Describe the development of the dental papilla?**

The dental papilla is of connective-tissue origin. Its position is first evidenced by a proliferation and condensation of the mesodermic elements. This collection of cells soon assumes the shape of a cone, its apex pointing towards, and later invaginated by the enamel organ. The apex and sides of the conical mass become surrounded by columnar cells—the odontoblasts, which are the producing agents of the dentine.

**By what cells, and under what conditions does resorption occur?**

Cells which are endowed with the function of breaking

down osseous tissue, namely, the *osteoclasts*, are active in the process of resorption. Resorption takes place previous to the eruption of the permanent teeth and is stimulated by the increased blood supply and pressure of the unerupted permanent teeth.

**Describe Meckel's cartilage.**

Meckel's cartilage is a rod of cartilage which appears in the mandibular arch and *partly* enters into the formation of the inferior maxilla, namely, the extremity at the symphysis and the proximal extremity, which persists with a covering of fibrous tissue to form the internal lateral ligament of the jaw. The greater part of Meckel's cartilage disappears at about the sixth month of fetal life.

**Name the specialized cell for each particular structure of the teeth.**

The specialized cell of the enamel is the ameloblast. That for the dentine is the odontoblast. For the cementum, the cementoblast.

**What are interglobular spaces?**

At the junction of the dentine with the enamel and cementum are areas which are imperfectly calcified; they are somewhat globular in shape, hence called interglobular spaces.

**Describe the dental follicle.**

The dental follicle is the result of the condensation of the mesodermic cells surrounding the papilla, which later extends upward so as to surround the entire rudimentary tooth.

**Why should there be a difference between the structure of dentine and cementum?**

Dentine is a product of embryonic connective tissue through the specialized cell, the odontoblast; while the cementum is produced by the connective tissue cells of the alveolar periosteum, the cementoblasts; therefore, the structure of the cementum resembles that of bone.



**Describe the enamel organ and the cells that form enamel.**

The enamel organ has its origin in a down-growth of the oral ectodermic tissue. When fully developed it consists of a sac, the lower margin of which is indented by reason of its contact with the underlying papilla; structurally, it consists of three layers of cells. An upper, continuous with the superficial cells of the ectoderm, a middle layer of stellate cells, and an inferior layer of distinctly columnar-shaped cells. The last-named cells are the cells which produce enamel. The enamel cells, when active in the production of enamel, exhibit, at their lower extremity (toward the papilla), a tuft of short processes. It is along these processes that the deposit of the enamel takes place.

**What is the primitive dental groove? (b) What organ of the teeth is developed from it?**

A longitudinal furrow, seen on the surface of the ectodermic tissue, which marks the point of attachment of the dental ridge lying immediately beneath. (b) The enamel organ.

**Describe the dental fibrillae; with what are they connected, and where do they terminate?**

The dental fibrillæ occupy the dental tubules and extend throughout their length. The fibrils are protoplasmic extensions of the odontoblasts terminating at the periphery of the dentine.

**Describe the stratum granulosm.**

At the periphery of the dentine, the substance is not completely calcified. As a result there are small irregular clefts, the interglobular spaces. This layer of the dentine is known as the granular layer.

**What is Neuman's Sheath?**

The part of the dentinal matrix immediately surrounding the dentinal tubules constitutes the so-called dentinal sheaths, or sheaths of Neuman.

**What is calcification?**

Calcification is the process by means of which tissue may become infiltrated with lime salts. It is a product of the cellular element of the tissue that is deposited in the intercellular substance of which it becomes a part. Calcification usually is effected in layers, and, in the instance of bone and cementum, well-defined lamellæ are formed.

**Mention the methods of distribution of cells in the various tissues.**

On surfaces (epithelium and endothelium).

Suspended in fluid (blood and lymph).

Interstitally, in a matrix (connective tissues).

**What is perichondrium?**

A fibrous investment covering cartilage. It consists of an outer fibrous, the vascular layer; an inner chondrogenetic layer, composed of spindle-shaped, cartilage-forming cells.

**Name the varieties of cartilage.**

White fibro-cartilage, yellow elastic cartilage, hyaline cartilage.

**Which variety of cartilage does not have a perichondrium?**

White fibro-cartilage.

**How may all tissues be classified?**

According to (1) their ancestry, (2) function, (3) morphological character.

**Explain the difference between epithelium and endothelium.**

Epithelium and endothelium occur on surfaces, but the location, the function and the arrangement varies.

	Epithelium.	Endothelium.
Ancestry	{ Ectoderm Entoderm Mesoderm (rarely)	Mesoderm
Function	{ Protective Secretory Absorptive Permit exchange of gases Motion Nervous	Reduction of friction
Morphological Character	{ Simple and Stratified Squamous Columnar and Polyhedral-shaped cells	Always in a single layer   Always squamous.

**What is meant by the ancestry of a tissue?**

Its origin in the blastoderm.

**What is the function of connective tissue?**

Connective tissue enters into the formation of the structure to make a supporting framework; especially where great strength is required. Blood-vessels, nerves and lymphatics are always carried in connective tissue.

**What is the structure of capillaries?**

Capillaries are the ultimate radicles of the vascular (arterial) system, and consist of a continuation of the lining of those vessels; being made of a single layer of endothelial cells, united by a small amount of intercellular cement substance.

**What cells form dentine?**

The odontoblasts.



## PHYSIOLOGY.

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**Give the sources of saliva and its chemical functions and otherwise.**

Saliva is the secretion of the parotid, submaxillary and sublingual glands. It contains a ferment, ptyalin, which converts starch into maltose. The saliva facilitates speech by moistening the mucous membrane of the mouth; and on account of its contained mucin, facilitates deglutition by lubricating the bolus of food. By dissolving some of the solids in the food it allows them to be tasted.

**Where and how are the products of digestion finally incorporated into the tissues?**

The digested food is absorbed mainly by the villi of the small intestines. The water, soluble salts, glucose and peptones are passed through the columnar epithelium of the villi into the capillaries. These capillaries are radicals of the portal vein, and through this vein the products are carried to the liver. The blood of the liver passes out through the hepatic vein into the inferior vena cava and thus into the general circulation. The peptones during their passage through the columnar epithelium are converted into albumens and globulins. The digested fat passes through the columnar epithelium of the villi into the central lymphatic vessel or lacteal. These lacteals carry the absorbed fats to the thoracic duct, which in turn empties them into the left subclavian vein, and thus into the general circulation.

**Describe the physiological process that takes place in the kidneys.**

The kidneys are compound tubular glands secreting urine.



The tubules commence in the Malpighian corpuseles in the cortex. After leaving these the tubules become convoluted, then pass down as the loops of Henle, again become convoluted, and finally empty into the collecting tubules. The convoluted portions are lined with roddeed epithelium, and it is by these cells that the urea is picked out of the blood. All the substances found in the urine are waste products circulating in the blood, and these the epithelium picks out from the blood. The one exception to this is hippuric acid, which is formed by the kidney cells.

### **Describe the stomach and its secretions.**

The stomach is the ovoid dilatation of the gastro-intestinal tract; and is a muscular sac lined inside with mucous membrane, and outside with a serous membrane. The food enters from the œsophagus at the cardiac orifice, and passes out into the duodenum at the pyloric orifice. The stomach has two curvatures, the upper, or lesser curvature, and the lower, or greater curvature. That portion of the stomach lying towards the spleen and forming a part of the greater curvature, is called the fundus. The stomach has four coats: serous, or outer; muscular, of which there are three distinct layers, circular, longitudinal and oblique; submucous; and mucous, imbedded in which we have the tubular glands that secrete the gastric juice.

The gastric juice is a limpid, acid secretion, specific gravity 1005, containing salts, hydrochloric acid (.2%), and two ferments, pepsin and rennin. About ten pints are secreted daily.

### **How is the skin kept moist and the cuticle pliable?**

The skin is kept moist by the sweat, and the cuticle pliable by the sebaceous secretion.

### **What are the sources of heat in the body?**

Heat is produced in the body by katabolism, principally in the muscular and glandular tissues.

**Trace the circulation of the blood once around its course beginning at the right auricle.**

The blood enters the *right auricle* from the superior and inferior vena-cavas, thence through the right auriculo-ventricular or *tricuspid valve* into the *right ventricle*, past the *pulmonary semilunar valve* into the *pulmonary artery* to the *capillaries* of the *lungs*; from the lungs it is carried back through the *pulmonary veins* to the *left auricle*, past the left auriculo-ventricular or *mitral valve* into the *left ventricle*, through the *aortic semilunar valve* into the *aorta* and its branches to the *capillaries* of *systemic* circulation, and from these it is carried back to the heart by the *systemic veins*.

**What is waste, and by what organs is it eliminated from the system?**

Waste is the product of metabolism of no further use to the organism. Waste is eliminated by the lungs, kidneys, skin and intestines.

**In what various ways is the loss by waste restored?**

By food, water and respiration; the blood acting as a medium of exchange.

**Describe the mechanical process by which the blood receives oxygen.**

The blood receives its oxygen in the lungs where the capillaries containing venous blood are separated from the oxygen of the air by a single layer of pavement epithelium. Three factors are concerned in the absorption of oxygen; mechanical law of pressure of gases, chemical affinity between hemoglobin and oxygen, and the vital activity of the epithelium of the air-vessels.

**By what special fluid is nourishment to the tissues delivered, and how?**

By the circulating blood, by osmosis through the capillary walls.

**Describe fully the preparation of pabulum for the blood.**

The starches are converted by ptyalin of saliva and amylase of pancreatic juice into maltose.

Maltose and cane sugar are converted into glucose by the invertase of succus entericus. Caseinogen is converted into casein by the rennin of gastric juice, and the milk-curdling ferment of pancreatic juice.

The proteids are changed into proteoses and peptones by the pepsin of gastric juice and the trypsin of pancreatic juice. Enterokinase of the succus entericus energizes the trypsin.

The fats are split into fatty acids and glycerine, saponified and emulsified by the steapsin of pancreatic juice and by the bile.

The digested food is then absorbed by the villi of the small intestines. The fats are carried by lacteals to the thoracic duct; and the glucose, water, soluble salts and peptones are carried by the portal vein to the liver, the peptones being changed into native proteids while passing through the epithelium of the villi.

**What is the medulla oblongata? Give a short description.**

The medulla oblongata is that portion of the central nervous system between the upper end of the spinal cord and the lower boundary of the pons varolii.

It is pyramidal in shape with the base upward, and is about one inch long, three-fourths of an inch wide and half an inch thick. Anteriorly is seen the anterior median fissure, the olivary bodies, and the anterior pyramids.

The posterior surface of the medulla forms part of the floor of the fourth ventricle, bounded on each side by the diverging posterior columns of white matter. Laterally we find emerging the cranial nerves from the sixth to the twelfth inclusive.

In structure we find that it is made up of gray and white matter.

The gray matter is cut up into small masses by the motor

and sensory decussations. These masses of gray matter form the nuclei for most of the cranial nerves.

**Describe the mechanism of the heart.**

The heart is a hollow muscular organ divided into four cavities, two on the right side and two on the left. Between the two sides there is no communication. The right side receives venous blood and forces it into the pulmonary circulation. The left side receives arterial blood and forces it into the general, systemic or greater circulation. The two auricles, contracting simultaneously toward the end of ventricular diastole, force the blood into the ventricles. The ventricles then contract, the auriculo-ventricular valves are closed, and the blood is forced into the arteries. The ventricles then relax and the blood flows in from the auricles, the auriculo-ventricular valves being open. The blood tends also to regurgitate into the ventricles from the arteries, but is prevented by the closure of the semilunar valves. The heart has been likened to a force-pump, but it is also a suction-pump, for during diastole, there is a negative pressure in the ventricles due to the elasticity of the muscular wall tending to produce a vacuum.

As to the nervous mechanism of the heart, we find in the medulla the cardio-inhibitory and the cardio-accelerating centers. The efferent nerve from the cardio-inhibitory center to the heart is the vagus or pneumogastric; the efferent from the cardio-accelerator center is the accelerator branch of the sympathetic system. These nerves end in ganglionic masses in the heart.

There is also an efferent nerve from the heart called the nervous depressor of Cyon and Ludwig; when there is danger of rupture of the heart from over-pressure, it is irritated and carries an impulse to the vasomotor center that depresses its tonus and lowers the blood pressure.

**Describe the pancreas, and the character and functions of its secretion.**

The pancreas is a tongue-shaped organ about six inches

long, weighing about two ounces and situated back of the stomach. It is sometimes called the abdominal salivary gland.

The duct enters the duodenum about an inch and a half below the pylorus. The bile duct joins with it just before it opens into the duodenum.

The pancreatic juice is a transparent, viscid, alkaline fluid, specific gravity 1012. There are about eight ounces secreted daily. It contains salts, especially sodium salts and four ferments. Amylopsin converts starch into maltose.

Trypsin converts proteids into peptones, and even into lower bodies, leucin, tyrosin and arginin.

Steapsin splits up the fats into fatty acids and glycerine. The fatty acids combine with the alkalies present to form soap and this aids the emulsification of the rest of the fat.

There is also a milk-curdling ferment.

The pancreas has also an internal secretion, as extirpation of the organ causes diabetes.

### **In what way does the blood lose material?**

By osmosis through the capillary walls into the tissues; by excretion from the lungs, skin, kidneys and liver, and by osmosis into gastro-intestinal canal, as in the watery stool following saline cathartics.

### **What is the cerebro-spinal axis, and what is its function?**

The cerebro-spinal axis is that portion of the nervous system consisting of spinal cord, medulla, pons varolii, crura cerebri, basal ganglia, cerebrum and cerebellum. Its function is to receive afferent impulses and to send out, as the result of these, efferent impulses, to keep the body in normal condition, and through the cerebrum presides over thought, volition and sensation.

### **What is the purpose of the lymphatic system and how fulfilled?**

The liquid portion of the blood osmotes through the capillary walls into the tissue. This diluted blood plasma is called



lymph. It bathes and nourishes the tissue and is carried by the lymphatics back to the general circulation through the thoracic duct and right lymphatic duct. They also carry absorbed material as the fat from the intestines, into the general circulation.

The secretion of some of the ductless glands is emptied into the blood through its lymphatics. The cells formed in the lymph glands become leucocytes.

**What chemical exchange is effected in the lungs during respiration?**

Oxygen is absorbed by the blood. Carbon dioxide, nitrogen, water and very small quantities of organic volatile principles are thrown off.

**How is the normal temperature of the human body maintained?**

The normal temperature of the body is maintained at about 98.4° F., by the proper balancing of heat production and heat dissipation. The production and dissipation of heat are controlled by the thermotaxic centers of the nervous system. These include the thermolytic, thermogenic and thermoinhibitory centers.

**Describe the process of deglutition and name the glands where secretions are an essential aid in the process.**

Deglutition is the act of swallowing or passing of the food from the mouth into the stomach. There are in this act three stages, buccal, pharyngeal and œsophageal. The first is voluntary, the last two are involuntary.

The bolus of food is forced by the tongue from the mouth into the pharynx, the muscular wall of which contracting from above downward forces the bolus into the œsophagus. A peristaltic wave of contraction then forces the bolus through the œsophagus into the stomach. Thus the deglutition of solids is a peristaltic act. But liquids are squirted through the pharynx and esophagus with bulb-syringe effect by contraction of the mylo-hyoid muscle.

The center of deglutition is in the medulla. It receives afferent impulses through the trifacial and glosso-pharyngeal nerves, and gives off efferent impulses through the inferior maxillary division of the trifacial and glosso-pharyngeal and vagus.

The glands whose secretion aids deglutition are the salivary, especially the submaxillary and sublingual; also the mucous glands of the mucous membrane of the mouth, pharynx and œsophagus.

**Name the digestive secretions, mentioning the principal action of each upon food.**

Saliva, gastric juice, pancreatic juice, bile and succus entericus are the digestive secretions.

Saliva converts starch into maltose.

Gastric juice converts proteids into peptones, and caseinogen into casein.

Pancreatic juice converts proteids into peptones, starch into maltose, splits up the fats into fatty acids and glycerine, and converts caseinogen into casein.

Bile emulsifies fats and prevents excessive action of bacteria.

Succus entericus converts maltose and cane sugar into glucose and energizes the trypsin.

**Give the apparent origin and general distribution of the pneumogastric nerve. Mention some of the organs whose action it influences.**

The superficial origin of the pneumogastric is from the groove on the lateral surface of the medulla between the olivary and restiform bodies. It is distributed to the pharynx, larynx, œsophagus, heart, lungs, stomach, and to the abdominal sympathetic system. It is the motor nerve to the pharynx; motor and sensory to the larynx; motor, sensory and respiratory to the lungs; motor, sensory and secretory to the stomach; cardio-inhibitory to the heart, and secretory to the pancreas, motor and inhibitory to the intestines.

**Describe the liver, its secretion and the function thereof.**

The liver is the largest gland in the body, weighing about four pounds, and measuring transversely about twelve inches, antero-posteriorly about seven inches, and at its posterior part is about three inches thick.

It is situated principally in the right hypochondriac region, but extends through the epigastrium into the left hypochondriac region.

It is divided by five fissures into five lobes, the largest of which is the right lobe. The most important fissure is the transverse; for through this the blood enters the liver through the portal vein and hepatic artery, and passes out through the hepatic vein. The bile also passes out through the hepatic duct through this fissure.

The secretion of the liver is bile.

Bile is a reddish-yellow, or reddish-green, alkaline, viscid, bitter liquid with a specific gravity of about 1020. There are about two or two and a half pints secreted daily.

It contains among other substances bilirubin, biliverdin, taurocholate and glycocholate of sodium, cholesterin, mucin and inorganic salts.

The bile neutralizes the acid chyme, precipitating the pepsin; emulsifies fats, and aids in their absorption; increases peristalsis; it is a slight antiseptic; and contains waste products thrown off by the liver.

**Mention the nutritive fluids of the body.**

Blood, lymph and chyle.

**What conditions affect the body temperature?**

All conditions affect the body temperature that destroy the balance between heat production and heat dissipation.

Among these you have muscular exercise, digestion, prolonged exposure to extremes of temperature, shock (mental or physical), hysteria, drugs (as antipyrin, chloral hydrate and atropine), toxins of bacteria, injection of peptones and ptomaines, irritation of any one of the thermotaxic centers.

**Give the composition of the pancreatic secretion.**

According to Halliburton you have 97.6% of water; 1.8% of organic matter of which the most important are the ferments; and .6% inorganic salts, among which are sodium chloride, sodium phosphate and potassium chloride.

**Give the properties of pancreatic juice, and state its reaction. Where does the pancreatic juice enter the intestine.**

The pancreatic juice is a colorless, transparent, viscid, alkaline fluid with a specific gravity of 1012. It contains four ferments; trypsin, amyllopsin, steapsin and a milk-curdling ferment.

The pancreatic juice enters the intestine through an opening in the posterior surface of the duodenum about its middle.

**Give the composition of blood, and state the use of each component part.**

The blood is composed of sixty parts of plasma or liquor sanguinis and forty parts of corpuscles.

The plasma is the liquid portion and contains about ten per cent. of solid matter, of which four-fifths are proteids. The solid matter is made up of serum albumen, serum globulin, fibrinogen, salts, glucose, fats and extractives.

There are two kinds of corpuscles, red and white.

The red corpuscles are the more numerous, the proportion being seven hundred reds to one white. The principal substance in the red corpuscle is the hemoglobin.

The white corpuscles have amoeboid movement, and have a phagocytic action. By their disintegration fibrin ferment is formed.

The red corpuscles carry the oxygen to the tissues.

The fibrinogen clots after leaving the vessel and thus stops bleeding.

The plasma carries the absorbed food to the tissues and the waste products to the excretory organs.

The blood also keeps the various parts of the body at a fixed temperature.

The function of the blood-plates is not known.

**State the difference between the vaso-constrictor nerves and the vaso-dilator nerves.**

The vaso-constrictors, when stimulated, decrease the caliber of the arterioles by causing a contraction of the muscular fibres in the middle coat of the vessels.

The vaso-dilators, when stimulated, increase the caliber of the arterioles by inhibiting or decreasing the tonus of the local vaso-motor ganglia in the muscular wall.

**Define voluntary muscle; involuntary muscle. Give example of each.**

The voluntary muscles are those under the control of the will, and are transversely striated. The biceps is an example of a voluntary muscle.

The involuntary muscles are those not under the control of the will, and are not transversely striated. The muscular coat of the arteries is an example.

**State the function of the hypoglossal or sublingual nerve.**

It is the motor nerve of the tongue and the muscles connected with the hyoid bone.

**What special centers exist in the medulla oblongata?**

Deglutition, salivation, mastication, vomiting, diabetic, cardio-inhibitory, cardio-accelerator, vaso-motor and respiratory.

**What is the function of the cerebrum?**

The cerebrum is the center of volition, sensation and ideation.

**What is the difference between proteid and amyloid foods?**

Proteids contain carbon, hydrogen, oxygen, nitrogen and sometimes phosphorus.

The amyloid foods contain carbon, hydrogen and oxygen;



the last two elements in the proportion to form water; and in the molecule, six atoms of carbon or a multiple of six.

The body can form amyloids from proteids, but cannot form proteids from amyloids.

**What is meant by flexion and extension of muscle?**

By flexion is meant the shortening or contraction of the muscle.

The relaxation or lengthening of the muscle is called extension.

**Give the location of the stomach. State the work accomplished by the stomach.**

It is situated in the front part of the upper abdomen in the epigastric region with its pyloric end a little below and to the right of the xiphoid cartilage, and its fundus projecting over into the left hypochondrium.

The stomach changes the proteids into peptones, curdles milk, and liquefies fats.

**Describe the stomach and its movements during digestion.**

The stomach is an irregularly ovoid, muscular sac, lined inside with mucous membrane, and outside with serous membrane. It is the dilated portion of the gastro-intestinal tract between the œsophagus and small intestine. The stomach holds, when full, about three pints. It has two openings, the cardiac, through which the food enters the stomach, and the pyloric, through which the food leaves the stomach. It has two curvatures, the upper or lesser and the lower or greater. The portion of the greater curvature lying toward the spleen is called the fundus.

When the food reaches the stomach the two orifices close tightly like sphincters; the muscular wall also contracts down upon the food, and by means of the three muscular layers keeps the food in constant motion. Thus it brings fresh portions constantly to the surface to be acted upon by the

gastric juice. A current passes down the fundus and greater curvature to the pylorus and back along the lesser curvature. After an hour of gastric digestion, the tightly closed pylorus gradually relaxes, allowing some of the liquid chyme to enter the duodenum. Finally, at the end of three or four hours, even the more or less solid undigested portion is allowed to escape and enter the duodenum.

**Describe the alveolar process and state how it is developed.**

The alveolar process is made of an inner plate and an outer plate, which are of compact osseous tissue. Between these plates there is a cancellous structure which is hollowed out into compartments for the different teeth.

The alveolar process is of mesoblastic origin, being formed by the osteoblasts of the periosteum. As the permanent teeth form, the process is somewhat rebuilt to accommodate them.

**What is the epiglottis?**

The epiglottis is one of the single cartilages of the larynx. It is found at the base of the tongue and on the anterior edge of the upper opening of the larynx.

**Describe (a) the arterial system, (b) the capillary system.**

The arteries are tubes that carry the blood from the heart to the capillaries. The systemic arteries commence in the aorta, which divides and subdivides. The cross-section of the aorta is much less than the combined cross-section of the arterioles. The arteries have three coats. The intima consists of a layer of endothelial cells on a basement membrane and numerous yellow elastic fibers; the media consists principally of involuntary muscular fibers, arranged circularly, which are controlled by the local vasomotor ganglia; the adventitia consists principally of areolar tissue containing some elastic fibers. The yellow elastic fibers are comparatively more abundant in the large arteries; the muscular more abundant in the arterioles.

The capillaries are small tubes consisting of a single layer of lance-shaped endothelial cells. They connect the smallest arteries with the smallest veins. They are about one-thirtieth of an inch long, and of sufficient caliber to allow a red corpuscle to pass through.

**How is bone nourished?**

Bone is nourished by the blood through the nutrient artery circulating in the marrow and Haversian canals. It is also nourished by the periosteum.

**State the importance of the blood to the body.**

The blood carries the food and oxygen to the tissues, and carries the carbon dioxide and other waste products from the tissues to the excretory organs.

It is also by the circulation of the blood that the temperature of the various parts of the body is equalized.

**State the influence of posture on the action of the heart.**

There is an increase of nine to sixteen pulse beats when one rises from a reclining to a standing posture; the volume and force of the pulse increases at the same time. The effect of the sitting posture is intermediate between the two.

**Mention three inorganic substances found in the body.**

**State in what part of the body each is found.**

Hydrochloric acid in the gastric juice.

Sodium chloride in blood.

Calcium carbonate in bone.

**What is the difference in function between the right and left sides of the heart?**

The right side receives venous blood and forces it through the pulmonary circulation.

The left side receives arterial blood and forces it through the systemic or greater circulation.

**Describe the physiological action of (a) saliva, (b) gastric juice, (c) pancreatic juice.**

The ptyalin of saliva converts starch into maltose.

The rennin of gastric juice changes caseinogen into casein, and pepsin in an acid medium converts proteids into peptones.

As to pancreatic juice, trypsin in an alkaline solution converts proteids into peptones or even into lower bodies, leucin, tyrosin and arginin. It also changes some of the albuminoids into peptone-like bodies. Amylopsin converts starch into maltose. Steapsin splits up the fat into fatty acids and glycerin. The milk-curdling ferment curdles milk.

**State the function of each of the following muscles: (a) temporal, (b) masseter, (c) occipito-frontalis, (d) orbicularis palpebrarum, (e) orbicularis oris.**

The temporal and masseter draw the lower jaw upward and are muscles of mastication.

The occipito-frontalis moves the scalp and raises the eyebrows. It is a muscle of expression.

The orbicularis palpebrarum is the sphincter muscle of the eyelid; and is also used as a muscle of expression.

The orbicularis oris is the sphincter of the mouth. It is a muscle of expression; and its contraction will carry the food backward into the oral cavity.

**State the normal pulse at each of the following ages: One year; ten years; fifty years.**

One year it is 115 to 120.

Ten years it is 80 to 90.

Fifty years it is 70 to 75.

**Why is blood light in the arteries and dark in the veins?**

Oxyhemoglobin found in the arteries is a lighter red than the deoxidized hemoglobin found in the veins.

**Is the natural condition of saliva alkaline or acid, and how is it tested?**

It is alkaline, and is tested with litmus or phenolphthalein.

**What is the normal temperature of the surface of the body?**

Very variable. The axillary temperature is about 98 degrees Fahr.

**Define assimilation.**

Assimilation is the conversion into protoplasm of the nutrient material or food ingested.

**State the use and importance of a (a) perspiration, (b) bathing.**

By the evaporation of perspiration the body is kept at a fixed temperature. The perspiration carries off waste products, keeps the skin pliable, and when need exists, relieves the kidneys of work.

Bathing cleanses the external surface, stimulates the function of the skin, and increases the general tone of the body.

**State the object of respiration.**

By the act of respiration oxygen is taken into the blood, and carbon dioxide, small quantities of nitrogen, water and some organic volatile substances are thrown off from the body.

In some animals the evaporation of water, and thus dissipation of heat by frequent respirations, is quite marked.

**Describe the movements of the heart.**

The two auricles contracting, force the blood through the auriculo-ventricular orifices into their corresponding ventricles. These in turn contracting, force the blood past the semilunar valves into the pulmonary artery and aorta. The blood is prevented from regurgitating into the auricles during systole by the closure of the auriculo-ventricular valves. The ventricles then relax to be refilled with blood from the auricles. At the same time the semilunar valves are closed by the blood attempting to regurgitate from the arteries.

During ventricular systole the heart becomes shorter and more globular, the base being forced down by the recoil from



the forcing of the blood into the aorta. The heart rotates a little during systole.

**Give the mechanical uses of saliva.**

Saliva assists in deglutition, in mastication, in speaking and in taste.

**In what way does absorption of food occur?**

Most of the food is absorbed by the villi in the small intestines.

Two factors are concerned in absorption,—osmosis and vital activity of the columnar epithelium of the villi.

The soluble salts, glucose, water and peptones are carried by the capillaries through the portal vein to the liver and from here into the general circulation.

The fat is carried by the lacteals to the thoracic duct, and through it into the left subclavian vein.

**What is the function of the liver?**

The liver secretes bile; it forms glycogen, urea, uric acid and conjugated sulphates. Some of the red corpuscles are formed and others destroyed in the liver. The liver also destroys some poisons in the circulating blood.

**What is the function of the muscles?**

The muscles move the various parts of the body, and produce most of the heat necessary to keep the body at the normal temperature.

**Give the symptoms of insufficient oxygen in the blood.**

Dyspnœa, cyanosis, increase of blood pressure, and finally exhaustion with decrease of blood pressure, weak, flabby pulse, irregular, shallow breathing, convulsions and death.

**Describe the sympathetic nervous system, and state its functions.**

The sympathetic nervous system consists of a double chain of ganglia extending from the base of the skull to the coccyx along the anterior surface of the vertebral column. These

ganglia are connected by intervening nerves. Besides this double chain of ganglia there are three large plexuses of fibers and ganglia (cardiac, solar and hypogastric) and numerous smaller plexuses. Proceeding from the plexuses are numerous nonmedullated nerve fibres.

The sympathetic system controls the movement of the abdominal viscera, and contains the vasomotor nerves and the cardio-accelerator.

**Describe the physiologic action of alcohol.**

Alcohol in small doses is a stimulant to the cerebrum, respiration, heart, and gastric mucous membrane. In large doses it is a depressant to cerebrum, respiration, heart, vasomotor system and gastric mucous membrane. It interferes with nutrition and causes a fall in temperature.

**Mention the valves of the heart and give their location.**

The mitral valve is located at the left auriculo-ventricular orifice.

The tricuspid valve is located at the right auriculo-ventricular orifice.

The aortic semilunar valve is located between the left ventricle and aorta.

The pulmonary semilunar valve is located between the right ventricle and pulmonary artery.

**Name five of the principal elements of the body.**

Carbon, hydrogen, oxygen, nitrogen and sulphur.

**Define function.**

Function is the normal activity of an organ or group of organs.

**State the normal temperature of an adult; the normal pulse of an adult.**

Normal temperature is 98.4 degrees Fahr.

Normal male adult pulse is 72 per minute.

**State why blood does not coagulate within the blood vessels.**

The blood does not coagulate on account of its contact with the endothelium of the intima.

**Describe the origin and fate of the red corpuscles.**

In embryonic life the red corpuscles are first formed in the Islands of Pander, later by the liver and spleen. After birth the red corpuscles are formed in the liver and spleen and the red marrow of bones, especially of the ribs.

They are probably destroyed in the liver and spleen.

**How does the blood coagulate?**

Fibrinogen, a proteid dissolved in the plasma, when acted upon by fibrin ferment in the presence of calcium salts is changed into fibrin. The clot consists of this insoluble fibrin in the meshes of which are the corpuscles. The fibrin ferment is formed by the disintegration of the white corpuscles.

**Where and how is the blood changed from arterial to venous, from venous to arterial?**

By the process of osmosis, the oxygen passes out through the capillary walls into the tissues and carbon dioxide passes into the capillaries; thus it is changed from arterial to venous in the capillaries of the tissues.

The venous blood is forced by the right ventricle into the pulmonary capillaries where the blood is separated from the atmospheric air by only the capillary wall and the squamous epithelium of the air cells.

There are three factors concerned in the exchange of the respiratory gases or changing the venous blood into arterial blood. The first is the physiological law of pressure of gases; the second, chemical affinity between hemoglobin and oxygen; and third, the selective vital activity of the epithelial cells of the air vesicles.

**State the effects of starvation on the human body.**

The bodily weight gradually decreases and the temperature

becomes subnormal. The fats are used up first, followed finally by the proteids, especially of the muscles. The amount of urea excreted is first decreased; but as the increased oxidation of proteids begins, the urea is increased. Finally death ensues from exhaustion.

The heart and central nervous system lose but little in weight.

**Give the physiological properties and the chemical composition of gastric juice.**

Gastric juice is a limpid acid liquid with a specific gravity of about 1005.

It is composed of about 99.5% water and .5% solid. The bulk of solids is made up of pepsin, rennin, and hydrochloric acid. Of the hydrochloric acid there are about two parts to the thousand.

**State the effects of battery currents on the normal human nerves.**

The faradic current stimulates them.

A nerve during the passage of a constant current through it, is said to be in a state of electrotonus. There is an increase of excitability at the negative pole or kathode, and decrease of excitability at the positive or anode.

**How is the process of nutrition carried on?**

The blood receives the digested and absorbed food and also the oxygen from the lungs. It carries these products to the tissues which take out what they need. The blood receives the waste and carries it to the various excretory organs. The lymphatics also carry some of the waste from the tissues and empty it into the venous blood.

**How does lime or other inorganic matter find its way into the blood?**

Lime and other inorganic matter enter the body in the food and drinking-water, and being absorbed by the villi of the small intestines are carried by the portal vein to the liver and then into the general circulation.

**Describe the structure and give the functions of the veins.**

The veins have three coats: The inner, composed of a layer of endothelial cells and elastic fibers; the middle, composed principally of involuntary muscular fibers, and the outer, composed of areolar tissue with numerous yellow elastic fibers.

Many of the veins, especially those of the extremities, contain valves which help the movement of the blood within them.

The veins carry the blood from the capillaries to the heart. They all contain venous blood except the pulmonary veins which contain arterial blood.

**State the characteristics of the parotid and submaxillary glands.**

The parotid secretion is thin, watery, poor in solids (.3% to .5%) contains no mucin, and has excellent penetrating powers.

The submaxillary secretion on account of containing a quantity of mucin, is ropy, contains 2% to 2.5% solids, is of a greater specific gravity, and is excellent for aiding deglutition. The mixed saliva has a specific gravity of about 1005, is alkaline, and contains especially ptyalin, potassium sulphocyanide, mucin, sodium chloride and other salts.

**Of what two great groups of substances is the body composed?**

Organic and inorganic.

**Mention the organs that compose the respiratory apparatus.**

The respiratory apparatus consists of the nose, pharynx, larynx, trachea, bronchi and air vesicles; also of muscles moving the thorax, the diaphragm, the nerves (afferent and efferent) and the respiratory center in the medulla.

**What are the three kinds of digestion?**

The three kinds of digestion are that of proteids, of carbohydrates and of fats.



**What are the direct sources of the heat of the body?**

The most of the heat of the body is produced by katabolic changes, especially oxidation, taking place in the muscular and glandular tissues.

**Describe the parotid gland and give its function. Give location of the parotid gland.**

The parotid gland, the largest of the salivary glands, lies below and in front of the ear. The gland empties its secretion by Stenson's duct into the mouth through an opening in the mucous membrane, opposite the second upper molar tooth. It is a compound racemose gland composed of acini lined with polyhedral cells resting on a basement membrane. Under this is a close network of capillaries. The parotid secretes saliva.

**State the functions of dental pulp.**

The dental pulp nourishes the dentine. The odontoblasts which it contains form the dentine. The pulp contains nerves which give sensation to the tooth and thus protects it indirectly.

**How many pairs of cranial nerves are there? What nerves supply the teeth?**

There are twelve pairs of cranial nerves.

The teeth are supplied by the superior and inferior maxillary divisions of the trifacial nerve.

**On what particular phenomena does the study of physiology depend?**

Physiology is the study of the phenomena of *living* organisms.

**How does alcohol affect digestion?**

In small doses by its irritant action on the mucous membrane it causes an increase in secretion of gastric juice.

Large doses retard digestion, especially that of the stomach.

**In what organs is the blood changed?**

It is changed in all the organs except the heart, but especially in the liver, kidneys, lungs, spleen, bone-marrow and skin.

**What percent. of the weight of the body is water? State the function of water in the body, and how it is eliminated from the body.**

About 75% of the body weight is water.

In all the fluids of the body, water acts as a general solvent, being necessary to secretion and the carrying of nutrition to and the waste products from the tissues. By its evaporation it dissipates large quantities of animal heat.

It is eliminated from the body by the kidneys, sweat glands, lungs and in feces.

**What set of muscles gives the horizontal motion to the inferior maxillary?**

Internal and external pterygoids.

**Define afferent and efferent nerves.**

Afferent nerves carry impulses from the periphery to the central nervous system.

Efferent nerves carry impulses from the central nervous system to the periphery.

**Name three kinds of food from which starch is derived, and give the percentage of starch in each.**

Potatoes 23.7%.

Wheat 70%.

Rice 84.5%.

**What is the function of the gustatory nerve?**

The gustatory nerve is the nerve of taste.

**What is casein, and where is it found?**

Casein is a coagulated proteid found in curdled milk and cheese.

**How does the blood circulate through the heart?**

The blood passes from the superior and inferior vena cava into the right auricle, which contracting, forces it through the tricuspid valve into the right ventricle. The right ventricle then contracts and forces the blood past the pulmonary semilunar valve into the pulmonary artery. This artery carries the blood to the lungs, and from these it is carried back through the pulmonary veins into the left auricle. Then it passes through the mitral valve into the left ventricle, which, contracting, forces the blood into the aorta.

**What is the function of the nervous system?**

The function of the nervous system is to carry afferent impulses from the periphery and as a result of such impression to send out efferent impulses, to receive impressions, to preside over thought, and to control the action of the various parts of the body.

**How may coagulation of blood be hastened?**

It may be hastened by increasing the temperature, injury to the vessel walls, contact with foreign matter and oxygen, agitation and addition of calcium salts.

**State how many of the seventy known elements form a practical part in making up the animal tissue, and mention the four most important of these elements.**

There are sixteen to nineteen elements found in the tissues of the body. Of these the most important are carbon, oxygen, hydrogen and nitrogen.

**What is food? State why milk is so nearly a perfect food.**

Food is that which, taken into the body, nourishes the tissues or supplies heat.

Milk is so nearly a perfect food because it contains all the chemical compounds necessary to life, that is, proteids, carbohydrates, fats, salts and water.

**What are proximate principles?**

Proximate principles are substances that enter into the composition of the body.

**Name three of the most important inorganic proximate principles, and state where they are found in the body.**

Calcium phosphate is found in bone.

Sodium chloride is found in the blood.

Water is found all through the body.

**Are inorganic ingredients of food necessary to sustain life? Why?**

They are necessary because they are indispensable constituents of the structure of the body,—as calcium salts in bone; because the alkaline bases are necessary to neutralize the acids formed by the proteid metabolism; because they are necessary for digestion and absorption, and because water is the general solvent of the body.

**Describe the lymphatic system and give its function.**

The lymphatic system consists of lymph capillaries, of numerous thin-walled vessels lined with endothelium, of lymphatic glands situated on these vessels, of the thoracic duct, of the lymphatics of the intestines called lacteals, and the spleen.

The thoracic duct begins in a dilated extremity called the cisterna magna about the level of the second lumbar vertebra, and runs up along the vertebral column emptying into the left subclavian vein. It receives the lymph from the lower extremities, abdomen, left lung, left arm and left face. The lymph of the right lung, right arm and right face is emptied through a small vessel into the right subclavian vein.

The lymphatic glands are found along the course of the lymphatic vessels, and are composed of lymphoid tissue in the center of which are cells rapidly undergoing karyokinesis. The lacteals are the lymphatic vessels of the intestines and carry the absorbed fats from the villi to the thoracic duct.

The lymphatic system carries back into the blood circula-

tion the blood plasma that has osmosed through the capillary walls into the tissues. It also forms leucocytes and carries the absorbed fat from the intestines into the general circulation. The secretion of some of the ductless glands passes through the lymphatics into the blood channels.

### **Describe the circulatory apparatus.**

The circulatory apparatus consists of the heart, arteries, capillaries and veins.

The heart is a hollow, muscular organ, lined inside with the endocardium and outside with the pericardium. It is pyramidal in shape, about  $5\frac{1}{2}$  inches long,  $3\frac{1}{2}$  inches wide, and weighs about ten ounces. It is divided into four cavities, two auricles and two ventricles. The ventricles are the most important cavities, the left ventricle being three times as thick as the right ventricle.

The arteries are the vessels that carry the blood from the heart to the capillaries. They all contain arterial blood with the exception of the pulmonary artery. Histologically they consist of three coats. The intima or internal coat is composed of yellow elastic fibers lined internally with a layer of endothelium; the media or middle coat is made up mostly of involuntary muscular fibers running transversely to the long axis of the artery; the adventitia or external coat is composed of areolar tissue containing numerous yellow elastic fibers. The vaso-motor nerves end in the ganglia in the muscular coat. The elastic fibers are found comparatively more numerous in the larger arteries, and the muscular fibers in the arterioles.

The capillaries are the small blood vessels connecting the smallest arteries with the smallest veins, and consist of a single layer of lance-shaped endothelial cells. The capillaries on an average are  $\frac{1}{36}$  of an inch long and  $\frac{1}{3600}$  of an inch in diameter.

The veins are similar in structure to the arteries but the coats are not so thick. Some of the veins, especially those



of the extremities, have valves which prevent the regurgitation of blood during muscular contraction.

**What disposition is made of gastric juice after serving its purpose in aiding digestion?**

The hydrochloric acid is neutralized by the alkaline bile and the pepsin is precipitated.

**Define endosmosis, exosmosis.**

Endosmosis is the passage of a liquid through a porous diaphragm from without inward.

Exosmosis is the passage of a liquid through a porous diaphragm from within outward.

**Give the foramen of exit, principal branches of distribution and function of the hypoglossal nerve.**

Anterior condyloid foramen; branches of distribution are: Meningeal, descendens hypoglossi, thyro-hyoid and muscular. It is the motor nerve of the tongue.

**Give the functions of that part of the facial nerve which is distributed to the oral cavity.**

Influences the sense of taste, mastication and the secretion of the submaxillary and parotid glands.

**What is the function of the fifth pair of nerves?**

The fifth nerve is the sensory nerve to the face, oral and nasal cavity, and the motor nerve to the muscles of mastication.

**What anatomical structures are engaged when the food passes from the mouth to the stomach?**

The tongue, soft palate, constrictors of the pharynx, uvula, pharynx and esophagus.

**What noticeable change would appear if the seventh nerve were excised?**

Complete loss of motion of the muscles of expression of the face.

**Mention the difference between parotid and sublingual saliva.**

The parotid saliva is thin and watery, while the sublingual is thick and viscid, as it contains much mucin. More ptyalin is found in parotid saliva than in sublingual saliva.

**What muscles are most active in opening the mouth?**

Digastric, genio-hyoid, mylo-hyoid and platysma myoides.

**Give in the regular order the normal average age at which the deciduous teeth are erupted.**

C. I. ....	5th to 7th month
L. I. ....	9th " 11th "
1st M. ....	12th " 14th "
Cuspids ....	14th " 18th "
2nd M. ....	18th " 25th "

**Name the muscles concerned in the act of deglutition.**

Extrinsic and intrinsic muscles of the tongue, tensor palati, azygos uvuli, palato-pharyngeus, superior constrictor of pharynx, middle and inferior constrictor of pharynx. also the muscular coat of the esophagus.

**What are the fluids of the mouth? Give their active principle and function?**

Saliva from the salivary glands, and mucus from the mucous glands. The active principle of saliva is ptyalin, that of mucus is mucin. The function of saliva is to soften and moisten the food and to convert starch into maltose. The function of the mucus is to keep the mucous membrane of the mouth moist.

**Give the period of eruption of the permanent teeth.**

1st M. ....	6th to 7th year.
C. I. ....	7th " 9th "
L. I. ....	8th " 10th "
1st B. C. ....	10th " 11th "
2nd B. C. ....	11th " 12th "
Cuspids ....	12th " 13th "
2nd M. ....	12th " 13th "
3rd M. ....	16th " 25th "

**Describe the two systems of nerves in the human body.**

The sympathetic nervous system consists of a double chain of ganglia anterior to the vertebrae, several large plexuses consisting of large ganglia and numerous nerve fibers and innumerable smaller plexuses supplying the involuntary muscular tissue. The nerves of the sympathetic system are non-medullated.

The cerebro-spinal nerves are medullated fibers given off from the cerebro-spinal axis. They are of two kinds. The efferent, supplying principally the voluntary muscular tissue and glands and afferent or sensory, carrying impressions from the various sense organs to the central nervous system.

**State how the nervous system influences digestion.**

The nervous system influences digestion by means of the various secretory nerves and their centres; by the motor and inhibitory nerves controlling the movement of the muscular tissue of the gastro-intestinal tract and through many afferent or sensory nerves starting innumerable reflexes.

**State the physiologic relation of the pneumogastric nerve to the stomach.**

The pneumogastric is the sensory, motor in great part, and secretory nerve to the stomach. It may also contain some inhibitory fibers to the muscular tissue of the stomach.

**Into what classes are proximate principles divided? Mention examples of each class.**

The proximate principles of the body are water, salts as sodium chloride, proteids as casein, carbohydrates as starch, and fats as olein.

**Describe the movements of the ribs during inhalation?**

During inhalation the ribs are raised anteriorly and rotated outward like the handle of a bucket laterally. They are fixed posteriorly to the vertebrae.

**Describe intestinal digestion.**

The partly digested acid chyme passes through the pylorus into the duodenum. The bile and pancreatic juice enter through a common duct into the duodenum. The glands of Brunner of the duodenal mucosa and the crypts of Lieberkuhn of the intestines, empty their secretion into the lumen of the intestine. The bile neutralizes the acid chyme, precipitating the pepsin, thus stopping gastric digestion. It also aids in the digestion of the fats.

The pancreatic juice contains four ferments: the trypsin changes the proteids into peptones, the amylase changes the starch into maltose, the steapsin splits up the fats and a milk-curdling ferment changes the caseinogen into casein. The invertin of the succus entericus changes the maltose into dextrose. The enterokinase energizes the trypsin, and erepsin breaks up the peptones into simpler bodies. We have also in the intestines microbic digestion with the formation of various gases, as hydrogen sulphide, carbon dioxide, aromatic bodies, as indol, phenol, skatol, etc.

**State the function of the facial nerve.**

The facial nerve is the motor nerve to the muscles of expression of the face.

**State the function of glycogen.**

The glycogen is used up principally by the muscular tissue to supply heat and mechanical energy.

**State where the absorption of proteids takes place.**

The proteids are absorbed principally through the villi of the small intestines.

**State how the act of inspiration is accomplished.**

Efferent impulses from the inspiratory centre are sent out to the various muscles of inspiration. The diaphragm contracts, its central tendon is lowered and the vertical diameter of the thorax is increased. The ribs are raised and rotated outward laterally, thus increasing the anterior, posterior and

lateral diameters of the thorax. The air then rushes through the trachea into the lungs to fill up the partial vacuum thus produced.

**Describe the act of mastication.**

The act of mastication consists in the breaking-up of the food and mixing it with saliva. This is accomplished by the teeth, assisted by the tongue and the muscles attached to the jaws and around the mouth. There are three classes of teeth; incisors or cutters, canines or tearers, and molars or grinders.

**What proportion of the weight of the body is blood? State with regard to blood (a) its specific gravity; (b) its reaction; (c) on what its color depends.**

About one-thirteenth of the body weight is blood; its specific gravity is about 1055; reaction alkaline. The color depends upon its contained hemoglobin.

**Name the successive divisions of the alimentary tract.**

The divisions of the alimentary tract are the mouth, pharynx, esophagus, stomach, small intestine (duodenum, jejunum and ileum), large intestine, (caecum, ascending, transverse and descending colon and sigmoid flexure), rectum and anus.

**What organs excrete waste and what does each thus remove from the system?**

The lungs remove the carbon dioxide, the skin removes excess of water and small quantities of organic material and supplements the action of the kidneys. The kidneys remove the urea, the phosphates and sulphates from the proteid katabolism, water, and excess of salts ingested in the food. The intestines remove waste thrown off by the liver, refuse of digestion and may at times supplement the action of the kidneys.



**State approximately the amount of saliva and of gastric juice secreted during 24 hours.**

There is secreted daily about two pints of saliva and ten to twelve pints of gastric juice.

**Are the albuminous matters solid or fluid? State where albuminous matters are found in the body.**

Albumens are solids but in the body are in solution.

They are found all over the body.

**Give the composition of perspiration.**

The perspiration contains about one per cent. of solid matter, two-thirds of which is inorganic (principally sodium chloride and one-third of organic (principally fats and fatty acids) with a little urea and epithelial debris.

**Describe the action of the nervous system on the salivary glands.**

There is a centre in the medulla that controls the secretion of saliva. The two efferent nerves from this centre are the auriculo-temporal for the parotid and the chorda tympani for the submaxillary and sublingual glands.

The terminals of many afferent nerves when stimulated will cause a reflex secretion of saliva. Among these are the trifacial terminals in the mucosa of the mouth, vagus terminals in gastric mucosa, gustatory terminals in the tongue, olfactory in the nose, and even the terminals in the uterine mucosa.

**State the effect produced by the blood while passing through the muscles.**

The blood while passing through the muscles becomes venous, giving up the oxygen of the oxyhemoglobin, supplies nourishment to the muscle, carries off waste, principally in the form of  $\text{CO}_2$ .

**State the function of the salivary glands.**

The salivary glands secrete a fluid containing a principle

called ptyalin which converts starch into sugar. It also aids in moistening the bolus of food, thus aiding the digestion.

**Describe metabolism.**

Metabolism is the chemical change going on in organized tissue.

**Describe secretions. State how the process of secretion is carried on.**

Secretions are those products of activity of the epithelium of glandular tissue that are of further use to the organism. The glands receive their nourishment from the blood. The supply of blood is under the control of the vaso-motor system. The cells under the stimulus of impulses through the secretory nerves, or as in the case of the pancreas, from substances circulating in the blood (secretin) pick out certain elements of the blood and form new substances, which are thrown out into the lumen of ducts of the gland. In the ductless glands, these products are thrown into the blood-vessels directly or indirectly, through the lymphatic system.

**State the character of the food absorbed by the lymphatic circulation and its manner of reaching the blood circulation.**

The fats are absorbed through the villi, carried by the lacteals to the receptaculum chyli, thence through the thoracic duct into the left subclavian vein.

**Define nerves of special sense.**

The nerves of special sense are the nerves carrying the afferent impulses from the various peripheral sense organs to the central nervous system.

**Describe reflex action. Give an example of a reflex action that is automatically performed.**

A reflex action is an afferent impulse followed by an efferent impulse and is independent of volition.

A blow on the solar plexus will cause a reflex slowing or stoppage of the heart.

**Describe a ganglion.**

A ganglion is a mass of nerve cells some distance from the central cerebro-spinal axis, and has nerve fibers entering and leaving it.

**Mention the organs necessary for a sensation.**

For a physiologic sensation there must be a peripheral sense organ, the sensory nerve or pathway from it and the cerebral center to receive the impression.

**State the average amount of sweat excreted in 24 hours. Is this excretion necessary to sustain life? Give reasons.**

The average amount of sweat per day is two pints.

It is a necessary excretion, as through the sweat most of the heat produced in the body is dissipated.

**Give the chemical composition of muscle.**

Muscle contains the proteids, myosinogen, myoalbumen and myoglobulen, small quantities of glycogen and inosite, extractives as urea, creatin and creatinin, a red coloring matter, myokematin and inorganic salts, especially potassium phosphate. It is normally alkaline, but when fatigued becomes acid, from the formation of sarcolactic acid.

**Describe the structure and state the functions of the skin.**

The skin consists of the cutis vera, formed of dense fibrous tissue, the superficial layer being raised into numerous papillæ. This is the vascular layer of the skin. The end bulbs of the sensory nerves are found here also. Covering the cutis vera is the epidermis, formed of numerous layers of epithelium. There are four strata of the epithelium: the outer, horny, or stratum corneum; the stratum lucidum; the stratum granulosum, and the inner or stratum mucosum.

The function of the skin is to protect the underlying soft parts from injury and drying, to protect the sense corpuscles, and through the sweat glands and blood-vessels to dissipate heat. The hair, an appendage of the skin, protects some of

the organs from cold, the brain from shock and prevents friction, as in the armpits.

**What causes the beat or pulsation of the heart?**

The rhythmic activity of the heart is due to intrinsic property of the heart muscle. According to Loeb it is controlled by the proper balancing of the ions of sodium, calcium and potassium.

**Has blood plasma an alkaline or an acid reaction? Give reasons.**

The blood plasma is alkaline in reaction, due to the dissolved alkaline salts, especially sodium carbonate and phosphate, that it contains.

**Describe by diagram or otherwise a transverse section of the spinal cord.**

The spinal cord is a rounded mass of white matter, imbedded in which is a central mass of grey matter, arranged like the letter H. The white matter consists of nerve fibers and the grey of nerve cells. These are held together with neuroglia. The projections backward of grey matter are called the posterior horns. These come to the surface of the cord postero-laterally. Here the posterior roots or sensory nerves enter the cord.

The projections forward of grey matter are called the anterior horns. Fibers starting here emerge from the antero-lateral surface of the cord. In the median line there is the anterior median fissure, projecting about one-third of the distance into the cord, and the posterior median fissure, projecting about half the distance into the cord. The white matter between the posterior horn and the posterior median fissure is called the posterior column and is divided into the two tracts of Goll (median) and Burdach. Between the anterior horn and the anterior median fissure is the anterior column, divided into the direct pyramidal (median) tract and the anterior ground bundle. The white matter between the two horns is called the lateral column and is divided into five

tracts; the crossed pyramidal tract, triangular in shape and found close to the posterior horn, then along the periphery of the cord from behind forward we have the direct cerebellar, anterior lateral ascending cerebellar (Gower's) and anterior lateral descending cerebellar (Löwenthal's) and deep in the lateral column is the deep lateral tract.

In the grey matter there are two especially well marked columns of grey cell, one situated at the base of the posterior horn (Clark's column), the other, the intermedio-lateral column, between the two horns laterally.



## HYGIENE.

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**Mention eight satisfactory disinfectants and give indications for their use.**

Formaldehyde (1 pound for every 1000 cu. ft. of space), sulphur (3 pounds for every 1000 cu. ft. of space) or bleaching powder (3 pounds for every 5000 cu. ft. of space) to fumigate a room. If sulphur or bleaching powder are used, it is necessary to steam the room before beginning to fumigate. Chloride of lime to disinfect excrementitious matter from typhoid fever, cholera, dysentery, etc. Carbolic acid (5% solution) or moist heat (steam and boiling water) to disinfect clothing. Bichloride of mercury or permanganate of potassium and oxalic acid to disinfect the skin.

**What are the most common sources of infection in diphtheria?**

By direct contact with the sputum or shreds of membrane from the patient. By inhaling the air in the vicinity of the patient. By fomites, clothing, books, drinking-cups, etc.

**What conditions are essential to a good water supply?**

Purity at its source, and adequate subsequent protection from contamination.

**Describe the hygiene of the mouth and teeth.**

The teeth should be cleansed after each meal and on rising in the morning, and foreign matter between the teeth should be removed. Acidity of the saliva may be counteracted by weak alkaline mouth washes.

**What methods would you suggest for the hygienic care of the skin?**

Simple foods; avoiding constipation; daily exercise in the open air; plenty of sleep (at least eight hours daily); frequent warm baths and a cold sponge bath on rising each morning.

**Name the kinds of food and the quantity of each for the daily use of the normal man.**

4.5 ounces of proteids; 3.5 ounces of fats; 14 ounces of carbohydrates; 1 ounce of salts (Moleschott). Or 118 grains proteids; 56 grains fats; 500 grains carbohydrates (Voit). These quantities represent dry foods. If the diet is stated as so-called solid-food (not water-free) the above quantities must be doubled. 50 to 80 ounces of water in liquid form are also taken into the system.

**Describe in detail the process of disinfection by formaldehyde (formalin).**

Make the room as near air-tight as possible by closing all openings and cracks before beginning the process of disinfection. All mattresses, pillows, clothing, books, etc., should be exposed as fully as possible to the action of the disinfectant. Place one pound of formalin for every 1000 cu. ft. of air space in a "Novy" generator. Start the rapid volatilizing of the formaldehyde and allow the room to remain closed for one day.

**What hygienic means should be employed by persons prone to "catch cold?"**

A cold sponge bath followed by brisk rubbing on arising in the morning; daily muscular exercise in the open air and a liberal (but not excessive) diet, largely of carbohydrates.

**What are the sanitary requirements of house plumbing?**

All pipes and connections, traps, etc., should be in view or easy of access. Each house must be directly connected by pipe with the common sewer. The pipes in the house must

be of iron with leaded joints or serewed couplings. The drainage pipes should be laid with a gradient of at least one inch fall to every four feet of length; the main house drain must be provided with a trap after it has been earried beyond all house eonneeting pipes. Pipes from water eloset fixtures, bath tubs, wash basins and sinks must have traps close to each fixture. Soil pipes must extend open for at least two feet above the roof and air must be admitted to the main trap upon its house-side.

**Describe a simple form of ventilating the sick-room.**

Place a wooden strip about three inches wide and as long as the window frame under the lower sash; through the space between the top of the lower sash and the bottom of the upper, suffieient air will enter the room without produeing a draught.

**What precaution should be taken in school rooms to protect the sight of scholars?**

Pupils should not sit faeing the windows (the light should come from behind or over left shoulder); blaekboards should not have a glossy surfaee or be plaeced between windows. The walls of the room should be of a neutral tint. Text books should be printed in clear, large type. Faulty posture in reading and writing should be corrected by the teacher. If toilet aecessories are supplied, no child suffering from an inflammatory disease of the eyes should be permitted the use of the general supply. Any imperfection in vision of a pupil should be reported to the parents.

**What are the chief sources of contamination to drinking water?**

The emptying of sewage into the stream from which the water supply is obtained; surface water in settled distriets gaining entranee to the supply; sub-soil water, after passing through a filthy soil; draining from plaees of burial; and water which has dissolved poisonous minerals.

**Describe the different methods of purifying drinking water.**

Sedimentation, occurring when collections of water remain at rest for a considerable time, removing, in part, at least, suspended matter.

Sand filtration in which the water flows upon and through prepared beds of sand, gravel and broken stone, packed in separate layers, removes from it not only suspended matter, but also dissolved organic matters and bacteria through the action of air (oxygen) in the interstices of the filter material, and the action of saprophytic bacteria.

Boiling water will free it of pathogenic bacteria and temporary hardness, but such water, after boiling, should be aerated to fit it for use.

**What do you understand by the "dry earth system" as applied to excrementitious matter?**

The container under the privy seat contains the dry earth, and after the use of the privy, fresh earth is always to be added to the receptacle. From time to time the contents are removed and buried or otherwise disposed of.

**Mention some of the results of tobacco smoking in growing school boys in respect to the circulation, air passages, vision and mental application.**

It depresses the circulation and produces palpitation of the heart. It causes low grades of inflammatory processes in the upper air passages, catarrhal conjunctivitis, mental lethargy with inability to sustained mental application.

**What habits of school children tend to produce myopia?**

Reading of small or imperfect print; faulty positions while reading or writing in which the eyes are not far enough removed from the page. Reading or writing in insufficient light, or when fatigued.

**What should be the proper temperature for a living room in winter?**

72° F. for old or weak persons; 65° F. for the young and vigorous.

**What should be the diet of a child over two years of age?**

The food should consist principally of milk and bread, with rice, tapioca, some vegetables of easily digestible character and sparingly of fruit, preferably cooked; but little meat should be allowed and this preferably mutton.

**What is the most sanitary way of disposing of city garbage?**

Burn it, so that all noxious vapors are also consumed.

**Mention six desirable factors in the location of a resort for consumptives.**

Equable climate, high altitude, dry atmosphere, pure air, abundant sunshine and pine forests are climatic factors for consumptives.

**State the accepted belief in respect to the limitation of protection from vaccination.**

Five years, when revaccination should be attempted. During a small-pox epidemic it is advisable to revaccinate all individuals who have not been vaccinated within two years.

**Mention some of the adulterations in preparations of ground coffee for sale in the shops.**

Chicory, peas, roasted cereals and legumes, date stones, acorns, sawdust, etc.

**What class of foods should predominate for persons over sixty years of age?**

Use eight-tenths the quantity of proteids that the vigorous adult requires; seven-tenths the quantity of carbohydrates; and one and two-tenth times the quantity of fats.



**Which in your judgment is to be preferred in vaccination, animal or humanized lymph, and why?**

Animal lymph, because in its preparation greater care may be taken to secure its freedom from deleterious additions.

**Name some of the nuisances dangerous to health.**

Gases and dust of a poisonous or irritating nature arising from many manufacturing industries. Collection of stagnant water, garbage and animal excreta exposed to the air; leaking drains or sewers saturating the soil, or allowing the escape of gases. Industries giving rise to great noise or vibration in thickly settled communities.

**What is the best means for preventing the access of sewer gas in dwellings?**

Place a trap or water seal between the house drain and the sewer, and provide an air inlet pipe to open into the drain pipe between this trap and the house. A ventilation pipe should extend from the house drain to a point above the roof.

**Name the diseases the predisposition to which is greatly increased by the use of alcohol.**

Disease of the heart and vascular system, the kidneys, brain and liver and of the respiratory system, particularly pneumonia and asthma.

**Name four diseases that are communicable to man through cows' milk.**

Typhoid fever, scarlet fever, cholera and tuberculosis.

**To what is indigestion from excessive tea drinking attributable? State a formula for the preparation of good tea.**

The indigestion is caused chiefly by tannin; also by theobromin.

Pour one pint of boiling water over a dram of the dried tea leaves and allow it to stand, without applying further heat, for five minutes.

**Mention some of the advantages of carefully prepared artificial ice as compared with natural ice.**

It may be made from distilled water so as to be absolutely pure. It may be obtained in any size or shape and its texture is more uniform.

**What precautions as to food and drink should be observed by those forced to work under the direct rays of the sun in summer weather?**

A small quantity of readily digestible food should be eaten before going to work. Liquids of a nonalcoholic character may be used liberally, provided perspiratory function is actively performed. Very cold drinks should be avoided. Meat should be largely excluded from the diet.

**What are the best methods of ventilating dwellings, and what sanitary principles are involved?**

The perflating action of wind should be utilized at least once each day for all rooms. One of the best methods employed is the open fireplace, provided such fireplaces be supplied with properly constructed chimney exits. Instead of this plan, fresh air may be admitted through ventilators, or between the upper and lower window sashes. The object sought in these devices is to admit cold air above the heads of the occupants of the room so that the fresh air may pass through the upper portions of the room and become heated before reaching the occupants. The usual outlet for foul air is the chimney flue, but when this is not present, it may be replaced by an opening for the exit of air placed near the floor of each room. When the incoming air is not heated the outlet should be at the top of the room. During cold weather the rate or interchange of air should not be greater than sufficient to change the air of the room three times an hour. The air which enters should not have a greater velocity than five feet per second or about 3.4 miles per hour.

**What hygienic precautions are necessary to insure healthy sleep?**

A well ventilated room, temperature about 60° F. Room and bed should be perfectly clean and the covers of the bed not too heavy. The head of the person should be slightly elevated. Noise and light should be excluded from sleeping apartments.

**What deleterious gases accumulate in improperly ventilated sleeping rooms?**

Carbon dioxid; carbon monoxid, if rooms be heated; hydrogen sulphid; ammonium sulphid, and many gases of an organic ammoniacal character.

**Does change in climate require any change in food; if so, what?**

Yes. In cold climates a greater quantity of food should be consumed than in hot climates. Food that is productive of the greatest number of heat units, as fats and meats, should be partaken of in cold climates. In hot climates the diet should consist almost entirely of well-cooked vegetables and ripe fruits; with the avoidance of alcoholic beverages.

**What are some of the dangers of the cold bath?**

In those of feeble circulation and at the two extremes of life, chilling of the surface of the body leading to internal congestion that may result in acute inflammation, particularly of the lungs, kidneys, stomach and bowels. Shock seriously affecting the heart; and the production of a persistently lowered temperature of the body.

**What effect has ground air and water on the health?**

Ground air is always impure, being contaminated with bacteria, carbonic dioxid and often with more poisonous gases. It occasions various degrees of ill-health, varying from slight general malaise to one of the acute infectious diseases or tuberculosis. Ground water from near the surface of polluted soils may be noxious. It causes dampness of the

walls of houses, inviting rheumatic diseases and catarrhal inflammations.

**Define the word "nuisance" in a broad hygienic sense.**

"Something which either actually injures, or is likely to injure health, and admits of a remedy either by the individual whose act or omission causes the nuisance, or by the local authority" (Winter-Blyth).

**What injurious influences, if any, do cemeteries exert on the health of persons living in their vicinity?**

To most persons the mental effect is depressing. Water passing through the soil of cemeteries may contaminate the water supply of the neighborhood, with organic material and micro-organisms. The constant turning of soil of cemeteries may set free imprisoned gases from organic decomposition, and lead to contamination of the surrounding air.

**What gases and combination of gases are most efficient as disinfectants?**

Formaldehyde, sulphur dioxid, chlorin, ozone.

**What care should be employed in exhumations?**

The exhumation of those dead of contagious or infectious diseases should not be allowed. When possible, the exhumation should be deferred until cold weather. The presence of all persons except those absolutely needed should be forbidden. As the workmen approach the coffin the earth should have poured upon it a strong watery solution of creolin. The coffins containing the remains should not be opened, but be placed at once in a zinc-lined box and hermetically sealed.

**What are the hygienic requirements and the physiological effects of bathing?**

The bath should be taken to obtain personal cleanliness, as well as for its stimulation of the peripheral circulation. Bathing should be postponed until at least two hours after a meal, and should consume only twenty minutes. Never bathe when very hungry, or when the body is overheated.

Unless experience has shown that good effects accrue from a cold bath, secure a temperature of about 65 to 75 degrees Fahr. of the water. The bath should be followed by a thorough drying and brisk rubbing. Effects following a bath are removal of dirt and of dead epithelium from the person, stimulation of the functional activity of the skin; a general improvement in the circulation and increased functional activity of the organs of elimination.

**How much fresh air is required for normal respiration during 24 hours?**

3000 cubic feet per hour, or 72,000 cubic feet of air in 24 hours.

**How may a privy in city or country be kept while in use from becoming a nuisance?**

Have the privy emptied at frequent intervals. At intervals of five to seven days, pour into the privy vault milk of lime (about 20 grains of lime for each gallon of sewage), or strong solution of iron sulphate; or at frequent intervals add clean, dry earth to the privy contents, and provide a ventilating pipe extending high in the air and down into the privy vault.

**What explanation can be furnished for the greater prevalence of diphtheria and small-pox in cold than in warm weather?**

During cold weather the houses are less perfectly ventilated than in warm weather. Rooms are frequently overheated, less attention is paid to personal cleanliness and there are more sudden changes in temperature. Such conditions lower the vitality of the body and predispose to disease.

**What are the principal adulterations of milk?**

Addition of water and abstraction of cream; addition of coloring water (annatto, caramel); preservatives (borax and boracic acid, salicylic acid, formaldehyde, chromates); gelatine as a thickening for cream.



**What changes in food are affected by cooking?**

Parasites and germs are destroyed; the food is made more tender to facilitate mastication. The tough fibrous envelope of starch cells is softened, albumen is coagulated, the food is rendered more palatable, and the action of the different digestive fluids is aided.

**State the advantages of cremation over earth burial.**

Complete destruction of specific disease germs. If cremation be well performed no obnoxious gases are given to the air, no gases of putrefaction contaminate the air, and there is no danger of contaminating the water supply through drainage from cemeteries.

**What are the respective merits of cotton, wool and silk when used as underwear?**

In a variable climate wool is preferable because from a larger amount of air enclosed in its texture it acts as a good non-conductor of heat, retaining the body heat. As wool is hygroscopic it readily absorbs moisture from which it parts slowly, so preventing surface chill of the individual by too rapid evaporation. Next in order to retain the heat of the body we rank silk and least valuable for the retention of body heat is cotton. If it be our purpose to supply a cool garment we would of course reverse this order of arrangement.

**What conditions of ill health make residence in high altitudes dangerous? Why?**

Chronic Bright's Disease, disease of the heart, emphysema; and old age. High altitudes occasion increased respiratory effort from the rarified condition of the atmosphere, causing increased heart action, and a lessened perspiratory function.

**State the physical condition that makes the practice of taking hot baths inadvisable.**

Acute inflammatory diseases, tuberculosis, organic diseases

of the heart and brain, aneurism, cancer, and all diseases in which stimulation of the circulation is to be avoided.

**State some of the sequelae of (a) over-strain, (b) over-exertion, (c) over-training.**

(a) Parting of continuity of osseous, ligamentous, muscular or bloodvessel structure leading to fractures, dislocations, rupture of muscles, hernia, rupture of heart muscles, disease of valves of heart and apoplexy.

(b) May produce same conditions as over strain and in addition cause general muscular relaxation, dyspnea, syncope, etc.

(c) Loss of appetite and of muscular power, successive crops of boils appear, individual loses mental power, as of concentration of thought, and digestive disturbances occur.

**What constitutes hard water and soft water?**

“Hardness is the capacity a water has for decomposing soap, and depends on the amount of salts of magnesia and calcium in solution.” (Harrington.)

Soft water contains little or no dissolved salts and rapidly forms a lather with soap.

**Mention the dangers of excessive shade about dwellings.**

Excessive shade interferes with the free movement of air, prevents penetration of the sun's rays, promotes dampness which is given off to the air by evaporation. It exerts a depressing mental action, promotes the growth of fungi and bacteria, and prevents the aspirating action of heat from the sun upon air and moisture in the soils.

**What is milk sterilization? How is it performed?**

Destruction of micro-organisms in the milk by heat. By continuous heating of the milk, under pressure, for two hours at 248° F.

**What infectious diseases may be due to impure drinking water?**

Typhoid fever, malarial fevers, cholera, relapsing fever, dysentery, parasitic diseases.

**Describe the physiological action of alcohol.**

Small or therapeutic doses increase the pulse rate and the arterial pressure by directly stimulating the heart. Overdoses directly depress and paralyze the heart muscle. Large doses produce decided lowering of body temperature. It is probable that the use of alcohol diminishes the elimination of  $\text{CO}_2$ . Alcohol causes a great lessening in the excretion of the products of tissue waste. It is probable that alcohol in not too large quantity is entirely destroyed in the body. In small doses alcohol acts as a cerebral stimulant, while larger doses greatly depress and abolish nervous activity, and check digestion. The habitual use of alcohol is accompanied by a disposition towards fatty degeneration, particularly of heart muscle, liver and kidneys, and an enlarged and dilated condition of the smaller bloodvessels and a degeneration of all nervous structures.

**Does alcohol possess a food action? On what do you base your answer?**

Yes. "In the sense that it is destroyed in the system and yields force utilized by the organism, and is, when in sufficient quantity, a retarder of tissue change, checking the excretion of nitrogen" (H. C. Wood). We see this in its administration in typhoid and other long-continued fevers. Yet it is not a true food, since it also exerts toxic effects, which foods do not.

**The excavations of streets in cities is frequently followed by the outbreak of disease, such as diphtheria, typhoid fever. What is the cause?**

Pathogenic bacteria lie dormant in the soil of cities, and when such soil is exposed to the air, it becomes dried, and its contained bacteria taking on an active existence are liberated and carried by the air to susceptible individuals.

**How long does a diphtheritic patient remain infective?**

**How may it be proved that this infective period has ceased?**

About three weeks after local symptoms cease. Make frequent cultures of material from the affected site, and when such fail to show the specific germ, the patient will no longer be a source of infection.

**How may milk be the means of transmitting the germs of typhoid fever?**

Through water containing Eberth's bacillus, gaining access to the milk, as through diluting the milk, washing milk receptacles in polluted water.

**Mention the effects of working in phosphorus, as in the manufacture of phosphorus matches. How can the dangers be limited or prevented?**

Inhaling phosphorus fumes produces a form of necrosis of the jaw, particularly in such as have imperfect teeth. To avoid its development persons of sound teeth and free from abrasion of the interior of the mouth should be employed. The work room should be large and well ventilated, with special air shaft to force the fumes away from the faces of workers; the employes should have short working hours, and frequently use a mouth wash and gargle of lime water or carbonate of sodium. Turpentine and charcoal should be exposed in the room.

**What fruits are preferable in cases of habitual constipation.**

Apples, prunes, figs, grapes and melons.

**Describe the effect of a hot and moist climate on the human system and state the class of diseases this atmosphere is likely to induce.**

In hot and moist climates the inhabitants, as a rule, are of small stature and deficient in muscular development; of languid disposition and nervous temperament. The diseases most prevalent are those affecting the liver and gastro-intes-

tinal tract; also various forms of malarial disease, and yellow fever.

**What occupations are a menace to public health? Why?**

Those occupations that emit irritating, poisonous or noxious fumes and gases from the vitiation of the atmosphere, as in fertilizing plants, chemical manufactories, bone-boiling establishments; also such occupations as give rise to much dust, especially if this be of sharp, hard character, as from cement making, in which the respiratory tract is subjected to irritation.

**Mention some of the objections to storage cisterns underground. What are the objections to rain water as a drink?**

They often receive dust and dirt; sewer gas may gain entrance to the water when the "standing waste" or overflow pipe of such cistern is connected with the drain or soil pipe of a house. Storage cisterns cannot be properly ventilated, and are often difficult to clean.

If the first part of the rain be collected, such water will contain dust, pollen, gases and other matters washed from the air.

**Give an opinion as to the sanitary effect of the different methods of heating houses.**

The most desirable method is by Hot Water Heating by means of a complete plant with circulation of the hot water through radiators. Next in value to hot water heating is steam heating by radiators or by indirect radiation. The use of open fireplaces in the principal rooms is of great value in securing ventilation, but yields an unequal and insufficient supply of heat. Heating a house by hot air from basement heaters is efficient and gives good results, if the air supplied to the heater for distribution is pure and the house is not too large.



**Name eight principal carbohydrates used as food.**

Starch, glucose, saccharose, lactose, dextrin, cellulose, maltose and dextrose.

**Name the class of foods which should be given to children between the first and second years of age.**

We should supply foods in about the proportion of 2 parts proteid, 3 parts fat, 6 parts carbohydrates, the proteid food being preferably milk.

**What are some of the dangers involved in the domestic use of ice?**

Ice may contain pathogenic bacteria, and may, when removed from a sickroom, transmit infectious disease to other members of the household.

**Define the term "quarantine," mention the principal quarantinable diseases, and give the rules for determining the length of time each should be quarantined.**

"The adoption of restrictive measures to prevent the introduction of diseases from one country or locality into another." (Wyman).

Quarantinable diseases include cholera, small-pox, yellow fever, plague, scarlet fever, diphtheria, typhus fever, relapsing fever, cerebro-spinal meningitis, leprosy.

In eruptive fevers isolation of the patient (quarantine) is continued for two weeks after the eruption has disappeared, except in the case of small-pox where quarantine lasts 30 days.

The quarantine in diphtheritic cases does not cease until cultures made from the throat of the patient fail to show the bacillus of diphtheria.

**State the best means of disinfecting sputum.**

Sputum may be burned or received into vessels containing strong antiseptic solutions.

**What is understood by the germ theory of disease?**

**Mention all diseases whose causes are known to be specific micro-organisms.**

The germ theory of disease contends that the exciting cause of each infectious or contagious disease is some specific organism, and that these diseases are communicated only by the transference to and development of the particular parasite or germ within or upon the tissues of the infected individual.

Diseases due to specific micro-organisms are tuberculosis, diphtheria, cholera, typhoid fever, dysentery, pneumonia, glanders, leprosy, anthrax, erysipelas, gonorrhea, relapsing fever, malaria, plague and tetanus.

**Can it be proved that the diminished death rate from diphtheria so generally announced is due to the use of diphtheria antitoxin? Give reasons.**

Yes. By comparing the death rate in hospitals treating the same class of patients, in the same community, during the same time, the one hospital using diphtheritic antitoxin, the other depending upon other methods of combating the disease. Where the antitoxin is used, the death rate is much lower.

**Give the comparative nutritive value of sterilized or unsterilized cows' milk.**

The nutritive value of sterilized milk is less than of milk unsterilized.

**What evil consequences frequently result from the excessive use of tobacco?**

Catarrhal inflammation of pharynx, tonsils and mouth. Nervous disorders of heart as palpitation, and insomnia also result. Derangements of stomach with loss of appetite, and impairment of vision together with paralysis of optic nerve, nervous tremors, and muscular twitchings may result.

**Mention five preventable diseases.**

Tuberculosis, typhoid fever, cholera, yellow fever and malaria.

**What is the best sanitary plan for the disposal of sewage?**

Collect the sewage in large tanks and to it add lime, alum or iron sulphate. Compress the solid materials after their subsidence or precipitation and cremate them. Allow the liquid sewage to flow upon specially prepared filter beds which are subdrained: the water flowing from these sub-soil pipes may then pass into a stream without great danger of adding poisonous material or pathogenic bacteria.

**What diseases are propagated by drinking water? How can their spread be prevented?**

Infectious diseases, particularly cholera and typhoid fever; diseases due to gastric and intestinal irritation, as forms of dyspepsia, diarrhoea, dysentery; diseases due to animal parasites; diseases due to metallie poisons.

Prohibit the use of water containing any dissolved metal. Distil the water, or boil it for at least one half hour, thus purifying it.

**State the results to animal life of the combustion of fuel in a room without chimney connection or other ventilation.**

Carbon monoxid poisoning, suffocation due to excessive quantity of carbon dioxide and diminished amount of oxygen; a systemic poisoning due to breathing products which are the result of partial burning of excretions thrown off in exhalations.

**State the original source of all fresh water.**

The original source of fresh water is rain.

**State the impurities which rain water may contain. Describe the great value of rain water for domestic purposes and state the great objection to its general use.**

Rain water may contain microscopic growths, bacteria, ammonia, nitric and nitrous acid and other impurities from the collecting surface.

On standing in the cistern many bacteria and other microscopic growths may rapidly render it unfit for use.

Rain water on account of its softness is of great value for cooking and washing purposes. The great objection to use generally is the limited and uncertain supply.

**In what part of an occupied room is the most impure air found? Give reasons.**

The lower part of an occupied room contains the most impurities. The carbon dioxide is heavy and tends to accumulate in the lower part of the room. The dust and other solid impurities are more abundant near the floor.

**State the composition of atmospheric air. Is the mixture a chemical or mechanical one?**

Atmospheric air is made up of 20.96% of oxygen, .04% of carbon dioxide and 79% of nitrogen and other inert gases as argon and crypton.

The mixture is a mechanical one.

**State the nervous disorders most common among school children. Mention some of the causes of these disorders.**

Among the many nervous disorders of school children are chorea, habit spasm, refractive errors of vision, deafness from catarrhal condition of nose, degeneracy, mental dullness and later in school life, neurasthenia.

Among the causes of these are overcrowding, faulty light, lack of proper ventilation, improper desks, lack of personal hygiene, heredity, cramming and lack of proper food and exercise.

**State the average proportion of carbon dioxide in 1000 parts of atmosphere. What should be the maximum limit of carbon dioxide in school rooms?**

Four parts of carbon dioxide to ten thousand of air is the normal.

The maximum limit of carbon dioxide in a school room should be .05%.

**State the hygienic precautions that should be taken to prevent the spread of typhoid germs.**

The drinking water should be boiled, and the milk also if it is suspected of possibly being infected.

The feces and all secretions, like urine and nasal mucus should either be destroyed by fire or properly disinfected with a strong solution of bichloride of mercury, chlorinated lime, formalin or carbolic acid.

The clothing of the patient and the bed linen should be placed in strong bichloride solution, or preferably boiled for a half hour.

The glasses and other dishes used by the patient should be boiled.

**What instruction as to hygiene and sanitation should be given in a case of diphtheria?**

The case should be isolated, the house quarantined, and possibly those who have been exposed (especially children) had better be given a small dose of antidiphtheritic serum.

The room should be well ventilated and as much sunshine as possible allowed to enter.

The discharge from the mouth and nose should be destroyed by fire; the dishes should be boiled.

The clothing and bed linen should be boiled or destroyed by fire.

After the case has terminated the room should be thoroughly disinfected with formalin or sulphurous acid, and the woodwork washed with 1 to 1000 bichloride of mercury solution.

**Name some of the impurities found in rain water that is stored in cisterns.**

Unicellular organisms of many kinds, decaying vegetation, nitrites, ammonia, nitric acid, and mechanical impurities.

**What are the general effects of breathing impure air?**

You get the symptoms of intoxication from the impurities



of the air, such as headache, general malaise, loss of appetite, interference with mental activity, also interference with muscular activity, weak, low-tension pulse.

**State the composition of pure air; of expired air.**

Pure air consists of 20.9 parts of oxygen, .04 parts carbon dioxide and 79.+ nitrogen and other inert gases. Expired air consists of 15.9 parts of oxygen, 4.5 parts of carbon dioxide and 79.+ nitrogen.

**If a chemical analysis of water revealed the presence of nitrites and nitrates, would this condemn it for drinking purposes, if so, why?**

Yes, particularly if nitrites be present. Organic matter, particularly sewage, is converted first into nitrites and these into nitrates through the action of bacteria in the soil. These salts would, therefore, indicate a former pollution of the water with probably some of that polluted material still in the water.

If nitrates only are present and it can be shown that the organic matter is of a vegetable origin only, the water need not be condemned.

**On what generally accepted theory are toxins used for the prevention and cure of disease?**

That their presence in the system renders the blood no longer able to support the lives of bacteria that occasion such toxins.

**Under what condition is tyrotoxicon found in milk, cheese and other articles?**

Where milk, cheese, ice-cream, etc., undergo decomposition in the presence of other organic matter, as rotting wood, mould, etc.

**Describe the agency of the ptomaines in inducing diseases and the disorders produced by them.**

Ptomaines are alkaloidal bodies resulting from decomposi-

tion of nitrogenous substances. When absorbed into the blood they may give rise to fever, headache, torpor, fetid breath. They act like chemical poisons very soon after their introduction into the system. Many of them occasion distinctive trains of symptoms.

**Mention an infectious disease which is often caused by drinking water and show how the germs of this disease are communicated to the water.**

Typhoid fever is frequently caused by drinking water. The excretions of the body are thrown on the ground or into improperly made cesspools, and then drain into the drinking wells, or the excretions are thrown into a creek or river and carried down to a city that uses this river as a supply for drinking water.

**State the number of cubic feet of oxygen absorbed in 24 hours.**

There are 27 cubic inches of pure oxygen absorbed in one minute or  $22\frac{1}{2}$  cubic feet daily.

**Mention six kinds of food from which starch is derived.**

Starch is derived from potatoes, corn, rice, wheat, oats and sago.

**What is the lowest temperature of steam heat at which pus cocci are destroyed?**

At 240 deg. Fahr. such organisms are killed in a few minutes, while at 212 deg. Fahr. it requires an exposure to steam of from thirty to forty minutes.

**What is the temperature of tepid water, of hot water, of boiling water?**

Tepid water 75 to 85 deg. Fahr.

Hot water 100 to 110 deg. Fahr.

Boiling water 212 deg. Fahr.

**Differentiate between endemic and epidemic diseases.**

An endemic disease is one constantly present in a commun-

ity. An epidemic disease is one which spreads rapidly, attacking many people at the same time.

**What is meant by natural and acquired immunity from disease? Give an example of each.**

By natural immunity we mean "that inherited trait from immune ancestors which enables an organism to resist the attacks of bacteria and their toxic secretions." Thus, as a rule the negro race does not contract yellow fever. By acquired immunity we understand that through a previous attack of an infectious disease, or by inoculation with an attenuated virus of that disease, the blood of the person undergoes such changes as to present a non-fertile soil to the organism to whose presence the disease is due. Example, vaccination in preventing small-pox.

**Describe vitiation of the air from lack of ventilation.**

The vitiation of the air from lack of proper ventilation is caused by the using-up of the oxygen, the accumulation of carbon dioxide and other waste products thrown off by the respiratory tract and skin.

**What should be the lowest specific gravity of fresh milk?**

The lowest specific gravity of fresh milk should be 1029.

**In 100 parts of cow's milk, mention the per cent. of proteids, fats, sugar, salts and water.**

There is in cow's milk about 4+ each of proteids, fats and sugar, about .7% of salts and the rest is water.

**State the advantages of a mixed diet.**

In a mixed diet one is more apt to get the right amounts of proteid, fats, carbohydrates and salts, the food is not too concentrated, nor does it contain too much waste, like cellulose. Proteids are absolutely necessary in the food. The vegetable foods are poor in proteid and the proteid is not as readily digested. Change of diet increases the appetite and

this physical influence is the most powerful in causing a proper flow of the various digestive secretions.

**State a method of disinfecting a room that has been occupied by a diphtheritic patient.**

The bedding, unless it can be subjected to superheated steam, had better be burned. The room should be thoroughly filled with abundance of formalin spray and kept closed for 24 hours. The room then should be thoroughly aired and exposed to the sunlight. The room should be repapered and the woodwork and the floor washed with a 1-1000 solution of mercuric chloride.

**How may the germs of infectious diseases be introduced into milk?**

The germs of infectious diseases may be introduced into milk by washing the milk cans with infected water, by watering the milk with infected water, from the hands of those handling the milk, from infected cows (as tuberculosis) and by contact of infected air with the milk.

**State the objection to the use of wells within the city limits.**

The objection to these wells is, they are very likely to drain the nearby cesspools and the surface sewage, unless they are thoroughly made wells that pass through at least one layer of solid rock.

**Does regular physical exercise affect the condition of the mouth? If so, how?**

It affects the condition of the mouth by increasing the tone of the whole body, stimulating especially the circulation and secretion.

**What is the best method of disinfecting instruments?**

The best method is moist heat.

**State what hygienic measures a dentist should employ after operating at a chair.**

He should clean the nose, throat and mouth with an anti-

septic solution; he should scrub the hands and place them in antiseptic solution for a few minutes.

The instruments should be sterilized and the room aired if possible.

**What hygienic care should be given to an operating room?**

An operating room should be well ventilated without draughts, well lighted, scrupulously clean, well heated and should be rendered as nearly aseptic as possible after a septic operation.





## ANATOMY.

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**What is connective tissue? (b) Where is it found in the human body?**

The term connective tissue includes a number of tissues which serve the purpose of "connecting" and supporting different tissues of the body. It is generally applied to tissue which fills in the interstices between organs, etc., and binds and supports them together. Most typically, it is found between muscles and surrounding blood-vessels.

**Give a general description of the nervous system.**

It consists of central and peripheral portions, the former made up largely of cells, and the latter of fibers. The brain and cord are contained in the cranial cavity and spinal canal. The brain, or encephalon, consists of cerebrum, cerebellum, pons and medulla; 12 pairs of nerves (cranial) pass out from these divisions through foramina in the cranial floor. The spinal cord has 31 pairs of spinal nerves attached to it. The cerebro-spinal axis is protected by 3 meninges, the dura, the arachnoid and the pia.

The peripheral nervous system consists of nerves of special sense, of motion and of sensation; many of them are mixed nerves, as to function. In the cervical and lumbar regions, the spinal nerves unite to form the cervical, lumbar and sacral plexuses.

The so-called sympathetic system, most intimately connected with the cerebro-spinal system, consists of collections of nerve cells known as ganglia, and of nerve fibers proceeding from these ganglia and uniting to form many plexuses,

the largest of which are the three prevertebral, or the cardiac, solar and hypogastric plexuses. From these plexuses fibers proceed to supply viscera and blood-vessels.

**Describe the sphenoid bone.**

By reason of its location at the base of the skull, it articulates with all of the bones of the cranium and with five of the face. It forms the greater part of the middle cerebral fossae; it consists of a body, two greater and two lesser wings, and a pair of pterygoid processes. The body is hollow and contains the sphenoidal cells, or sinuses; between the greater and lesser wings, on each side, is the sphenoidal fissure, which transmits the ophthalmic division of the 5th cranial nerve, the 3d, 4th and 6th cranials, and ophthalmic vein. On the upper surface of the body is the sella turcica, which receives the pituitary body; on either side of the body is the groove for the cavernous sinus; in the greater wing are the foramina rotundum, ovale and spinosum, for the maxillary division of the 5th, the mandibular division of the 5th, and the middle meningeal artery, respectively. The greater wing forms, anteriorly, part of the wall of the orbit, and externally, part of the temporal fossa; the pterygoid process helps to form the pterygoid fossa, externally, and the outer wall of the posterior naris, internally.

**State the location, size and structure of the cerebellum.**

Is located in the cerebellar fossae of the occipital bone, beneath the tentorium cerebelli; it measures four (4) inches transversely, and is about two (2) inches thick; in structure it resembles the cerebrum to the extent that it has a cortex which is made up of cells (gray matter), surrounding a white center consisting of nerve fibers, and which also contains a special nucleus, the corpus dentatum. The cerebellum is connected with the mid-brain (mesencephalon) by the superior peduncles, with the pons (epencephalon) by the middle peduncles, and with the medulla (metencephalon) by the inferior peduncles.

**Describe the trachea and give its anatomical relation.**

It extends from the larynx to the bronchi, and consists of a series of transversely directed, incomplete rings of cartilage united by an elastic membrane which contains involuntary muscle-fiber posteriorly, where the cartilaginous ring is deficient; it is lined with a mucous membrane which is covered with ciliated columnar epithelial cells.

The trachea rests upon the esophagus, being flattened posteriorly; in the groove between these two structures is the recurrent laryngeal nerve, upon each side; the common carotid artery, internal jugular vein and pneumogastric nerve are close to it at its lower portion, while the isthmus of the thyroid body crosses it upon its second and third rings, and the lobes of the same rest upon it laterally.

**Give the number and name the bones forming the skull.**

There are 22 bones in the skull: Cranium, 8 bones, viz., occipital, 2 parietal, frontal, 2 temporal, sphenoid, ethmoid. Face 14 bones, viz., 2 nasal, 2 superior maxillary, 2 lachrymal, 2 malar, 2 palate, 2 inferior turbinated, vomer, inferior maxillary.

**Give the origin, insertion, action and nerve supply of the gastrocnemius muscle.**

Arises by 2 heads from the posterior surface of the condyles of the femur and adjacent part of the shaft; inserted by tendo Achillis into os calcis; action, to extend foot upon leg; nerve supply, internal popliteal.

**What structures pass through the foramen magnum?**

Spinal cord, meninges, spinal accessory nerves (2), vertebral arteries (2), anterior and posterior spinal arteries.

**Name and give the origin and insertion of the muscles which depress the lower jaw.**

Genio-hyoid, from inferior genial tubercle of mandible behind symphysis into body of hyoid bone; mylo-hyoid, from mylo-hyoid ridge of mandible, into body of hyoid bone; an-

terior belly of digastric, origin from inner surface of mandible, near symphysis, into central tendon, attached to body of hyoid bone.

**Give the blood supply of the tonsils.**

Ascending pharyngeal, tonsillar branch of dorsalis linguae, ascending palatine and tonsillar branches of facial, and descending palatine branch of internal maxillary.

**Mention the branches of the facial artery.**

Tonsillar, ascending palatine, muscular, glandular, submental, inferior labial, inferior and superior coronary, lateral nasal, angular.

**Describe the mandible.**

The mandible, or inferior maxillary bone, consists of a horseshoe-shaped body which corresponds in shape with the alveolar border of the upper jaw, and extends upward and backward on either side as a ramus, which is surmounted by a coronoid process and a condyle, separated from each other by the sigmoid notch. The anterior extremity of the body projects as the mental protuberance (a characteristic of the human jaw), and the posterior end of the body, where it joins the ramus, is called the angle. Just anterior to this angle is a groove for the facial artery; the alveolar process, or border, contains sockets for the teeth, and is relatively thicker in the child's jaw, than in the adult's; behind the symphysis are the genial tubercles, while laterally from these are the depressions for the digastric muscles; more posteriorly still are the shallow fossae for the submaxillary glands; upon the inner surface of the body, running downward and forward, is the mylo-hyoid ridge, for the mylo-hyoid muscle; the ramus is roughened externally for the masseter, and internally for the internal pterygoid muscle; upon the inner surface of the ramus is the inferior dental foramen, which leads into a canal of the same name; to the coronoid process is attached the temporal muscle, while the condyle articulates with glenoid fossa of the temporal bone.



**Describe the hyoid bone.**

Is placed transversely above the thyroid cartilage, consisting of a centrally located body connected laterally with two greater wings, and supporting, at the junction of the body and greater wing, on each side, the lesser wing. The hyoid bone supports the tongue and has twenty muscles attached to it.

**Describe the ethmoid bone.**

The ethmoid bone is a light spongy bone consisting of a central portion and two lateral masses. The central part presents a horizontal plate, perforated for the transmission of olfactory nerve filaments, hence called cribriform. Projecting upward from the anterior median portion of the horizontal plate is the crista galli, serving for the attachment of the falx cerebri. From the under surface of the cribriform plate depends the perpendicular plate, which forms part of the nasal septum. The lateral mass, on each side, consists of two curling pieces of bone, the superior and middle turbinals, attached to the ethmoidal cells, which are limited externally by a smooth plate called the os planum, which assists in the formation of the inner wall of the orbit. Descending from the lateral mass is the unciform process which articulates with the inferior turbinated bone, and assists in forming part of the inner wall of the antrum of Highmore.

**Give origin, insertion and action of the buccinator muscle.**

Origin, from the alveolar processes of the superior and inferior maxillary bones, and behind, from the pterygo-maxillary ligament. Its superior fibres blend with the fibres of the orbicularis oris in the lower lip, its inferior fibres with the fibres of the orbicularis oris muscle in the upper lip. Its action is to assist in keeping the food between the teeth in mastication; it is used in such acts as whistling and in blowing a trumpet.

1 **What nerve supplies the muscles of expression?**

The facial, or seventh cranial nerve.

2 **What nerve supplies the muscle of mastication?**

Branches of the inferior maxillary division of the fifth cranial nerve.

3 **Mention the muscles attached to the occipital bone.**

Twelve pairs: Occipito-frontalis, sterno-mastoid, trapezius, splenius capitis et colli, complexus, obliquus capitis superior, rectus capitis anticus major and minor, rectus capitis posticus major and minor, rectus capitis lateralis and superior constrictor of pharynx.

4 **Give the course and relations of the external jugular vein.**

It begins in the lower part of the parotid gland, on a level with the angle of the mandible, and courses downward from the angle of the jaw to the middle of the clavicle; it crosses the sterno-mastoid muscle, lies beneath the platysma myoides, and terminates in the subclavian vein.

5 **Name the three classes of articulations.**

Synarthrosis, amphiarthrosis and diarthrosis.

6 **What nerves pass through the sphenoidal fissure?**

The third, fourth, ophthalmic division of the fifth, and the sixth cranial nerves.

7 **Give the origin, insertion, nerve supply, and action of the pterygoid muscles.**

The external pterygoid muscle arises by two heads. The upper head arises from the inferior surface of the great wing of the sphenoid below the pterygoid ridge, the lower from the outer surface of the external pterygoid plate. Its fibers pass horizontally backward and outward to be inserted into the depression in front of the neck of the condyle of the lower jaw, and into the interarticular fibro-cartilage.

Internal pterygoid muscle arises from the pterygoid fossa

and is inserted into the inner surface of the ramus and angle of the lower jaw.

Nerve supply, mandibular division 5th cranial. Action, both external pterygoids throw lower jaw forward, while each, acting alternately, produces triturating movement; internal pterygoids bring lower jaw up against upper jaw, and assist external pterygoids in carrying jaw forward.

1 **Mention the arteries from which the superior maxillary bone derives its blood supply.**

Alveolar, anterior and middle dental, branches of infra-orbital, and sphenopalatine and posterior palatine, branches of internal maxillary.

2 **Describe the salivary glands. Where do these glands empty?**

Parotid, submaxillary, sublingual. Parotid, largest, placed in front of ear, behind ramus of mandible; duct (Steno's) passes across masseter muscle, perforates buccinator muscle, terminates in cheek wall opposite upper middle molar. Parotid gland has facial nerve, external carotid artery, temporo-maxillary vein passing through it.

Submaxillary gland is located upon inner side of body of mandible posteriorly, and is crossed by facial artery; duct (Wharton's) passes forward, terminating close to fraenum linguae.

Sublingual gland, located in shallow fossa upon inner side of body of mandible, near symphysis, is covered by mucous membrane of mouth; ducts (of Rivinus and Bartholin) terminate near fraenum linguae.

3 **What bones enter into the formation of the orbital cavities?**

Frontal, sphenoid, ethmoid (3 singles); lachrymal, superior maxillae, malar, palate (4 pairs).

4 **Describe the frontal bone and give its articulations.**

The vertical portion forms the forehead, is convex ex-

ternally, presents two slightly raised eminences, the frontal, one to either side of the median line, while below them are the superciliary ridges, and below the latter, the supra-orbital arches, which terminate externally and internally in the external and internal angular processes, respectively. Each supra-orbital arch presents the supra-orbital notch, or foramen, at the junction of its inner and middle thirds. Between and below the two superciliary ridges is the glabella; the lateral segment of the vertical portion forms part of the temporal fossa, and the temporal ridge has its beginning in the external angular process, curving upward and backward. Upon the inner surface of the vertical portion are irregularities corresponding to cerebral convolutions; longitudinally placed is the groove for the superior longitudinal sinus.

The horizontal portion is composed of the two thin orbital plates, separated from each other by the ethmoidal notch, which is filled in by the ethmoid bone; these plates are smooth and concave underneath, but irregularly convex above.

Frontal bone articulates with both parietals, both malars, both nasals, both lachrymals, both maxillae, and with the ethmoid and sphenoid.

### **Describe the temporal bone.**

Is made up of 3 divisions, squamous, mastoid and petrous.

Squamous bone has vertically placed scale-like plate which forms large part of temporal fossa externally and of middle cerebral fossa internally; zygomatic process curves forward from it, while beneath is the glenoid fossa for condyle of mandible, located just behind eminentia articularis, and in front of tympanic plate (anterior wall of tympanum and external auditory canal).

Mastoid bone is placed behind, is rough and convex externally and projects downward and forward as mastoid process; beneath are digastric fossa for posterior belly of digastric muscle, and occipital groove for occipital artery; within substance of mastoid are mastoid cells, the largest of which

is called mastoid antrum, which communicates with middle ear; upon cerebral surface of mastoid is sigmoid groove for lateral sinus.

Petrous bone is pyramidal and is wedged in between squamous and mastoid bones; base presents oval opening, the external auditory meatus, to rough edge of which (auditory process) auricle is attached; apex, directed forward and inward, is notched to help form middle lacerated foramen, for entrance of internal carotid artery into cranial cavity; cranial aspect of petrous bone forms ridge for attachment of dura (tentorium), a depression near apex for Gasserian ganglion, and upon posterior surface, the internal auditory meatus, for auditory and facial nerves; petrous bone forms bony part of external auditory canal, the middle ear, and contains the osseous labyrinth; upon its under surface are to be found, near the center, the beginning of the carotid canal, behind and to the outer side of which is the jugular fossa, which, with a notch on the occipital bone, completes the jugular foramen; the styloid process, surrounded by the vaginal process at its base, may be seen projecting downward, forward and inward; the stylo-mastoid foramen, giving entrance to the stylo-mastoid artery and exit to the facial nerve, is to be found between the styloid and mastoid processes.

Temporal bone articulates with 5 bones: occipital. parietal, sphenoid, malar and mandible.

### 1 Describe the ophthalmic artery.

Is a branch of internal carotid, given off just after carotid has left cavernous sinus; it enters orbit by passing through the optic foramen, courses toward internal angular process where it divides into frontal and nasal. Branches are lachrymal, ciliary, arteria centralis retinae, muscular, anterior and posterior ethmoidal, palpebral and supra-orbital.

### 2 Describe the pulmonary veins.

They are four in number, usually, 2 for each lung, and return arterial blood from lungs to left auricle of heart.



1 **Describe the otic ganglion.**

Is a small, flattened ganglion situated immediately beneath foramen ovale; it receives motor and sensory roots from mandibular division of the 5th cranial; the small superficial petrosal nerve also enters it, furnishing branches of communication from the glosso-pharyngeal (sensory) and facial (motor); the sympathetic fibers come from the middle meningeal plexus. Its branches of distribution are to the tensor tympani and tensor palati muscles, and to the chorda tympani nerve.

2 **Give a brief description of the facial nerve.**

The 7th cranial nerve, after passing through facial canal (aqueductus Fallopii) of temporal bone, emerges at the stylo-mastoid foramen, and enters substance of parotid gland. Here it divides into 2 sets of branches, temporo-facial and cervico-facial, supplying muscles of expression. Its chorda tympani branch traverses inner surface and membrana tympani, after leaving main trunk in facial canal, and emerging through one end of the Glaserian fissure unites with lingual branch of 5th and accompanies it to submaxillary gland and ganglion and anterior  $\frac{2}{3}$  of mucous membrane of tongue.

**Describe the hypoglossal nerve.**

The 12th cranial nerve leaves cranial cavity by anterior condyloid foramen and descends almost vertically to a point corresponding with angle of jaw; it loops around occipital artery, then lies above hyoid bone, supplying intrinsic muscles of tongue. A communication from 1st and 2d cervical nerves after uniting with hypoglossal, leaves it to form descendens hypoglossi, branches from which are distributed to extrinsic muscles of tongue and depressors of hyoid bone.

**Describe the nasal bone and give its articulations.**

It forms "the bridge" of the nose, is oblong in shape, concave longitudinally, convex transversely; is grooved posteriorly for branch of nasal nerve; upper margin is thick and

serrated, while lower is thin, and notched; upper margin articulates with frontal bone, while lower has lateral cartilage of nose attached to it. It articulates with frontal, ethmoid, maxilla and opposite nasal.

**Mention the muscles attached to the temporal bone.**

Fifteen, viz.: temporal, masseter, occipito-frontalis, sternomastoid, splenius capitis, trachelo-mastoid, digastric, retrahens, aurem, stylo-pharyngeus, stylo-hyoid, stylo-glossus, levator palati, tensor tympani, tensor palati, and stapedius.

**Give origin and insertion of each of the muscles of the palpebral region.**

Three: orbicularis palpebrarum, corrugator supercilii and levator palpebrae. Orbicularis palpebrarum: origin, internal angular process of the frontal bone, and nasal process of the superior maxilla; passes outward around the circumference of the orbit and is inserted, some fibres into the tarsal ligaments, others forming a complete ellipse; the remaining fibres blend with the surrounding muscles.

Corrugator supercilii: origin, from the inner extremity of the superciliary ridge, passing out to be inserted into the skin.

Levator palpebrae: origin, the under surface of lesser wing of sphenoid above and in front of optic foramen. It passes outward along the roof of the orbit, becomes aponeurotic, and is inserted into the upper margin of the superior tarsal plate.

**Describe the superior longitudinal sinus.**

It extends from the crista galli of ethmoid to internal occipital protuberance of occipital; it increases in size as it is traced backward, draining the cortex of the cerebral hemispheres of venous blood. It usually becomes continuous with right lateral sinus.

**Describe the subclavian vein.**

A continuation of the axillary, it extends from outer bor-

der of 1st rib to near sterno-clavicular joint, where it unites with internal jugular to form innominate vein (brachio-cephalic). It is anterior to subclavian artery, on 1st rib separated from the artery by anterior scalene muscle. Its tributaries are external and anterior jugular veins; the left, at its point of junction with the internal jugular, receives the thoracic duct.

1 **Describe the submaxillary ganglion.**

Small in size, is situated upon deep portion of submaxillary salivary gland; is connected with lingual (gustatory) nerve, and receives a branch from chorda tympani of facial; it communicates with sympathetic plexus around facial artery. Branches of distribution are to mucous membrane of mouth and Wharton's duct.

2 **Describe the ophthalmic nerve.**

1st division of 5th, is entirely sensory. It arises from Gasserian ganglion, and before passing through sphenoidal fissure into orbit, divides into 3 branches, viz., lachrymal, frontal, nasal.

Lachrymal supplies lachrymal gland, conjunctiva and upper eyelid.

Frontal, largest branch, divides into supratrochlear and supra-orbital, supplying skin of upper eyelid and of forehead, and integument and pericranium over half of head as far as occiput.

Nasal branch leaves orbit by anterior ethmoidal foramen, enters nose and supplies mucous membrane of nose and integument covering ala.

3 **Name the arteries and nerves of the gums.**

Arteries are branches of internal maxillary, anastomosing with branches of facial artery through cheek wall. Nerves are from maxillary and mandibular divisions of 5th cranial, and branches from Meckel's ganglion.

**What bones encase the brain and what is their relative position?**

Occipital, both parietals, frontal, both temporals, sphenoid and ethmoid. Occipital is behind and below, parietals are above and at the sides, frontal is anterior, temporals are beneath and at the sides, sphenoid and ethmoid are beneath, anteriorly.

**Describe the spinal column.**

It consists of 33 separate vertebrae, distributed as follows: 7 cervical, 12 thoracic, 5 lumbar, 5 sacral, 4 coccygeal. Sacral and coccygeal coalesce early in life by ossification of intervertebral substances; cervical segment possesses curve with convexity forward, thoracic with convexity backward, lumbar with convexity forward, sacral with convexity backward; line of gravity passes through chords of these curves. Special, or peculiar, vertebrae are: atlas, axis, 7th cervical (vertebra prominens); ribs articulate with thoracic series; ilia articulate with sacrum. Spinal column contains neural canal for spinal cord.

**What are tendons and their function?**

They are rounded (cord-like) or narrow (ribbon-like) bundles of white fibrous tissue attaching muscles to bones or forming ligaments of joints, (shoulder, hip).

**Describe the elbow-joint and the manner of its lubrication.**

Is a ginglymus, or hinge-joint, made up of lower end of humerus and upper ends of radius and ulna: head of radius articulates with capitellum, and greater sigmoid cavity of ulna with trochlear surface of humerus. Its capsule is divided into anterior and posterior, internal and external lateral ligaments. It permits of flexion and extension. It is lubricated by synovial membrane lining its capsule.

**Describe the knee-joint and its manner of lubrication.**

Trochlear surface of condyles of femur, upper surfaces of

tuberosities of tibia, and posterior surface of patella form its bony parts. These are completely surrounded by a capsule which is strengthened antero-laterally by aponeurotic insertions of vastus externus and internus and by fascia lata; externally by a special band, or thickening, the external lateral ligament, and internally by the internal lateral ligament; posteriorly by the reflected tendon of the semimembranosus muscle.

Internal ligaments are anterior and posterior crucial, between intercondyloid notch of femur and non-articular surface around spine of tibia; also 2 semilunar fibro-cartilages, attached to spine of tibia. while the internal is also attached to internal lateral ligament.

Synovial membrane is large, lines capsule and is reflected into interior of joint around crucial ligaments, its folds here containing fatty tissue; it is extended upward beneath quadriceps tendon.

#### **What muscles are involved in respiration?**

Diaphragm, external and internal oblique, transversalis and rectus, of abdominal walls, external and internal intercostals, serratus posticus superior and inferior.

#### **Give the muscles of facial expression.**

Occipito-frontalis, corrugator supercilii, orbicularis palpebrarum, levator labii superioris alaeque nasi, levator labii superioris, levator anguli oris, zygomaticus major and minor orbicularis oris, depressor anguli oris, depressor labii inferioris and platysma myoides.

#### **Describe the joint in which the mandible works and the tissues constituting the joint.**

Bony parts are glenoid fossa and articulating eminence of temporal bone. and condyle of mandible; ligaments form a capsule, much stronger externally and posteriorly; external lateral ligament extends between tubercle of zygoma and neck of condyle; associated ligamentous bands are spheno-mandibular and stylo-mandibular; an interarticular cartilage con-



tained within the joint cavity has tendon of insertion of external pterygoid muscle attached to it. Movements permitted are depression and elevation of jaw around a transverse axis, and a sliding forward of both sides, protruding chin, or of one side at a time, producing a triturating movement.

**Name the bones of the head and face and give the articulations of the maxilla.**

Cranium: occipital, 2 parietal, frontal, 2 temporal, sphenoid, ethmoid. Face: 2 Lachrymal, 2 malar, 2 nasal, 2 maxillae, 2 palate, 2 inferior turbinated, vomer, mandible.

Maxilla articulates with 9 bones: Frontal, ethmoid, nasal, lachrymal, malar, palate, inferior turbinated, vomer and opposite maxilla.

**Describe the shoulder-joint.**

Variety, enarthrodial (ball-and-socket); bones, glenoid fossa of scapula, head of humerus; ligament, capsular, which is intimately blended with tendons of insertion of subscapularis, supraspinatus, infraspinatus and teres minor muscles; tendon of long head of biceps passes within capsule over humeral head, and is surrounded by synovial membrane; movements, flexion, extension, abduction, adduction, rotation and circumduction.

**Describe the superior maxillary bone.**

Consists of body and nasal, alveolar, palatal, and malar processes.

Body is irregularly cuboidal, contains cavity called maxillary sinus (antrum of Highmore), which is lined with mucous membrane in recent state; its external surface presents eminences corresponding to roots of teeth, also incisive fossa, near median line, and canine fossa, to outer side of canine eminence; above canine fossa is infra-orbital foramen, the termination of infra-orbital canal which traverses orbital surface; posterior, or zygomatic, surface is convex and forms

part of zygomatic fossa; it presents orifices of posterior dental canals, for dental vessels and nerves; internal surface is irregular, contains turbinated crest for articulation of inferior turbinated bone, groove for naso-lachrymal duct and helps to form outer wall of nasal meati.

Maxillary sinus (antrum of Highmore) is large, pyramidal, has thin walls, opens into middle meatus of nose by aperture which is narrowed by articulating with ethmoid above, inferior turbinated below and palate bone behind.

Nasal process projects upward, forming lateral wall of nose, articulating with nasal, frontal and lachrymal bones; alveolar process is thick, spongy and contains alveoli (8 in number) for teeth; malar process is thick, rough and serrated for articulation with malar bone; palate process is directed horizontally inward and articulates with fellow of opposite bone and with palate bone behind; its superior surface is smooth and slightly concave from side to side, forming floor of nasal chamber, and rough beneath, where it constitutes roof of mouth; at anterior end of it is to be found anterior palatine canal, situated in median line.

Give origin, insertion, action and nerve supply of the **omo=hyoid muscle**.

Origin from superior border of scapula and occasionally from suprascapular ligament; insertion into body of hyoid bone; beneath sterno-mastoid it develops a central tendon which is held down to 1st rib and clavicle by a process of deep cervical fascia; action, to depress hyoid bone and to support soft parts of neck during prolonged or difficult inspiratory efforts by making tense the cervical fascia; nerve supply, cervical nerves through descendens and communicates hypoglossi.

Give the origin, insertion, action and nerve supply of the **genio=hyo=glossus muscle**.

Origin, superior genial tubercle of mandible; insertion, into deep part of tongue close to median septum, or raphe, from

tip to base, and into body of hyoid bone; action, to protrude base and retract tip, and to make tongue concave transversely; nerve, hypoglossal.

1 **Describe the superior thyroid artery.**

Branch of external carotid formed just above thyroid cartilage, curves inward and downward, giving off hyoid, muscular, superior laryngeal, crico-thyroid and glandular branches to interior and exterior of larynx and to thyroid gland.

2 **Describe the mylo-hyoid nerve.**

Is a branch of inferior dental nerve given off just as the latter is about to enter inferior dental canal; mylo-hyoid nerve passes forward and downward in groove on inner surface of body of mandible, and supplies mylo-hyoid and anterior belly of digastric muscles.

3 **Describe the os planum.**

Is a smooth, horizontally oblong plate of bone forming outer boundary of lateral mass of ethmoid and part of inner wall of orbit; it articulates with frontal above, lachrymal anteriorly, maxilla below and with sphenoid and palate bone posteriorly.

4 **Mention the number of points of ossification of the inferior maxillary bone, and describe its development.**

Five centers of ossification.

Is developed chiefly in membrane, but partly from cartilage, ossification commencing earlier than in any other bone except clavicle. Most of the bone is formed from center of ossification which appears between 5th and 6th week in membrane on outer surface of Meckel's cartilage; 2d center appears on inner surface of Meckel's cartilage and develops into inner wall of tooth-sockets; anterior extremity of Meckel's cartilage ossifies and forms body of jaw; separate centers appear in condyle, coronoid process and angle. At birth mandible consists of 2 halves united by a fibrous symphysis, which ossifies during 1st year.

**Give origin, insertion, action and nerve supply of digastric muscle.**

Origin, posterior belly from digastric groove on under surface of mastoid portion of temporal, anterior belly from inner surface of mandible near symphysis; posterior belly extends downward and forward, anterior belly extends downward and backward, both to be inserted into a central tendon which perforates tendon of insertion of stylo-hyoid and is held to hyoid bone by fibrous loop. Action, raises tongue, in deglutition, and when hyoid bone is fixed by its depressors the digastric will depress lower jaw. Nerve supply: anterior belly by mylo-hyoid branch of inferior dental, posterior belly by facial nerve.

**Mention the muscles of mastication and give their origin and insertion.**

Temporal: origin, from temporal fossa between temporal ridge above and pterygoid ridge below, and from external angular process of frontal to mastoid process of temporal, also from inner surface of temporal fascia; into coronoid process of mandible.

External pterygoid: origin, by two heads, upper from under surface of great wing of sphenoid, lower from outer surface of external pterygoid plate; insertion into neck of condyle of mandible and interarticular fibro-cartilage of temporo-mandibular joint.

Internal pterygoid: origin, from pterygoid fossa; insertion into inner surface of angle and ramus of mandible as high as dental foramen.

Masseter: origin, from malar process of maxilla and lower border and inner surface of zygomatic arch; insertion into external surface of ramus of mandible.

**Mention the muscles attached to the hyoid bone.**

Genio-hyo-glossus, genio-hyoid, mylo-hyoid, stylo-hyoid, aponeurosis of digastric, hyo-glossus, middle constrictor of pharynx, sterno-hyoid, thyro-hyoid, omo-hyoid.

### 1 Describe the aorta.

Springs from left ventricle, anteriorly, extends upward to upper border of right 2d costal cartilage, then arches backward to left and descends through thorax, resting upon vertebral bodies, passes through aortic opening in diaphragm and courses through abdominal cavity as far as body of 4th lumbar vertebra.

Branches are 2 coronary from ascending portion; innominate, left common carotid and left subclavian from arch; bronchial, intercostal, pericardiac, esophageal and posterior mediastinal from thoracic portion; 2 phrenic, lumbar, sacra media (parietal branches), coeliac axis (gastric, hepatic, splenic), superior mesenteric, inferior mesenteric (single branches from front), suprarenal, renal, spermatic (or ovarian) (lateral paired branches) from abdominal portion.

### 2 Describe the superior vena cava.

Is formed by union of right and left innominate (jugulocephalic) veins, just below cartilage of 1st rib (close to right border of sternum; is nearly 3 inches long and terminates in right auricle; it receives vena azygos major.

### 3 Describe the fissure of Rolando.

It is boundary line between frontal and parietal lobes of brain, extending from point at or near great longitudinal fissure just behind midpoint between anterior and posterior poles of cerebrum, downward and forward at angle of  $67^\circ$  with the sagittal axis, for a distance of  $3\frac{3}{4}$  inches. Ascending frontal convolution forms its anterior wall, and ascending parietal convolution its posterior wall.

### 4 Describe the inferior maxillary nerve.

Motor root of 5th cranial unites with 3d branch of Gasserian ganglion to pass through foramen ovale, then to divide into an anterior and a posterior trunk; anterior, smaller and mostly motor, is distributed to muscles of mastication; posterior, mostly sensory, divides into auriculo-temporal, lingual and inferior dental.



**1 Mention the muscles attached to the sphenoid bone.**

Temporal, external pterygoid, internal pterygoid, superior constrictor, tensor palati, levator palpebrae superioris, superior, inferior, internal and external recti, and superior oblique.

**2 Describe the Vidian nerve.**

Begins in cartilage filling up middle lacerated foramen by union of large superficial petrosal (branch of facial) with large deep petrosal (from carotid plexus), passes forward through Vidian canal to enter sphenomaxillary fossa, here joining Meckel's ganglion.

**3 Mention the branches of the occipital artery.**

Muscular, sterno-mastoid, auricular, meningeal and arteria princeps cervicis.

**4 Describe the palato-glossus muscle. Give origin, insertion and nerve supply.**

Origin, anterior surface of soft palate close to uvula; insertion, into side and substance of tongue; action, to constrict fauces and retract tongue; nerve supply branch of spinal accessory.

**5 Describe the internal jugular vein.**

Is formed just below jugular foramen by lateral and inferior petrosal sinuses; courses down neck beneath anterior border of sterno-mastoid muscle in a common sheath with internal carotid (above), common carotid (below), and pneumogastric nerve, the latter behind and between, and the artery to the inner side of the vein, which partially overlaps the artery. Behind sternal end of clavicle it unites with subclavian to form innominate vein. Its tributaries are facial, lingual, pharyngeal, superior and middle thyroid veins and sometimes the occipital vein.

**6 What muscles control the soft palate?**

Tensor palati and levator palati, azygos uvulae, palato-glossus and palato-pharyngeus.

1 **What are the terminal branches of the external carotid artery?**

Superficial temporal and internal maxillary.

2 **Describe the maxillary sinus (or antrum of Highmore).**

Is a triangular cavity contained in body of maxilla, lined with mucous membrane and communicating with middle meatus of nose through one or two small openings; apex of cavity is formed by malar process of maxilla; base is formed by outer wall of nose; in its posterior wall are posterior dental canals for posterior dental vessels and nerves to the teeth; in floor are usually seen several elevations, corresponding to roots of 1st and 2d molar teeth.

3 **What forms the circle of Willis?**

The 2 internal carotids, 2 anterior cerebrals connected by anterior communicating, 2 posterior communicating and 2 posterior cerebrals.

4 **Describe the gustatory (lingual) nerve.**

Is a branch of posterior trunk of mandibular division of 5th cranial, lying deeply placed beneath external pterygoid muscle where it is joined by chorda tympani nerve from facial; it takes a deep course until it gets beneath mucous membrane of floor of mouth, where it is distributed to papillae and mucous membrane of anterior  $\frac{2}{3}$  of tongue.

5 **What are the articulations of the malar bone?**

With 4 bones: frontal, sphenoid, temporal and maxilla.

6 **Name articulations of the occipital bone.**

With 6 bones: two temporal, two parietal, sphenoid and atlas.

7 **Describe the inferior dental artery and name its branches.**

Is a branch of the 1st division of the internal maxillary artery, passing into inferior dental canal at dental foramen, accompanied by inferior dental nerve, coursing along inferior

dental canal to mental foramen, opposite 1st bicuspid tooth, where it divides into an incisor and a mental branch. The former remains within the jaw to supply the anterior teeth, anastomosing at symphysis with the incisor branch of the opposite side, while the latter escapes at the mental foramen to supply chin structures.

Branches are: lingual, accompanying lingual nerve to mucous membrane of floor of mouth; mylo-hyoid, accompanying mylo-hyoid nerve to mylo-hyoid muscle; branches which enter pulp cavities at apices of roots; terminal branches, incisor and mental.

1 **What artery supplies the tongue with blood?**

Lingual. (The principal one).

2 **Name the articulations of the temporal bone.**

Occipital, parietal, sphenoid, malar and mandible.

3 **Name the muscles of the tongue and their attachments.**

Intrinsic: divisions of lingualis. Extrinsic: genio-hyoglossus, hyo-glossus, stylo-glossus, palato-glossus.

Lingualis consists of superior lingualis(longitudinal fibers), transverse lingualis, inferior lingualis and vertical lingualis. These bundles and strata of muscular fibers intersect each other, being attached to under surface of mucous membrane and to raphé.

Genio-hyoglossus, origin superior genial tubercle; insertion deep surface of tongue and body of hyoid bone. Hyoglossus, origin body, greater and lesser cornua of hyoid; insertion side of tongue. Stylo-glossus, origin styloid process; insertion side of tongue. Palato-glossus, origin anterior surface of soft palate; insertion side of tongue.

**Describe the lingual artery and give its branches.**

Is a branch of external carotid, formed near greater cornu of hyoid bone, runs in curved manner forward to beneath hyo-glossus muscle, then in tortuous course to tip of tongue under name of ranine artery. Branches are, hyoid, dorsalis linguae, sublingual, ranine.

**Describe the occipito-frontalis.**

Arises from outer  $\frac{2}{3}$  of superior curved line of occipital bone and from mastoid bone as posterior belly which blends with centrally placed aponeurosis on vertex, which is continued forward into anterior belly, the latter being united to the orbicularis palpebrarum, corrugator supercilii and pyramidalis nasi. Action, to raise brows, produce transverse wrinkles of forehead and move scalp backward and forward.

**What muscles control the eye?**

Superior, inferior, internal and external recti; superior and inferior oblique.

**Which artery is the longer, the external or the internal carotid?**

Internal carotid.

**Mention the muscles of the pharynx.**

Superior, middle and inferior constrictors (2 each), palatopharyngeus and stylo-pharyngeus.

**Describe (a) facial vein, (b) the internal maxillary vein.**

Facial vein begins by an anastomosis with angular vein near inner canthus, passes downward and outward diagonally across face, turns over body of mandible in front of masseter muscle and unites with branch from temporo-maxillary vein to form common facial, this, in turn, emptying into internal jugular.

Internal maxillary vein accompanies artery of the same name, receiving tributaries which correspond to branches of the artery, and communicating freely with facial vein and cavernous sinus (through foramen ovale and middle lacerated foramen). Internal maxillary vein then unites with temporal vein, forming temporo-maxillary vein.

**Give the branches of the external carotid artery.**

Ascending pharyngeal, superior thyroid, lingual, facial, posterior auricular, occipital, temporal and internal maxillary.

1 **What muscles have their origin from the styloid process?**

Stylo-glossus, stylo-hyoid, stylo-pharyngeus.

2 **Give the origin and insertion of the sterno-mastoid muscle.**

Origin, by 2 heads, one from inner third of superior border of clavicle, the other from front of manubrium sterni; insertion into mastoid process and outer  $\frac{1}{2}$  of superior curved line of occipital bone.

3 **Describe the tensor palati.**

Origin from scaphoid fossa of sphenoid and margin of Eustachian tube, extends downward, has tendon which hooks round hamular process of internal pterygoid plate, then to be inserted into aponeurosis of soft palate and into horizontal portion of palate bone.

4 **What bones articulate with the vomer?**

Sphenoid, ethmoid, 2 palate, 2 maxillae.

5 **Describe the sphenoidal fissure.**

Is located between orbital and cranial cavities, a triangular gap between the greater and lesser wings of sphenoid bone. Its inner end is broad and rounded, its outer, narrow and pointed; its long axis extends outward, forward and upward. It transmits the 3d, 4th, the 3 branches of the ophthalmic division of the 5th cranial nerves, and the ophthalmic vein.

6 **Describe the glenoid fossa.**

Is found upon under surface of temporal bone behind articulating eminence and in front of tympanic plate; is crossed by Glaserian fissure; posterior part receives upper end of parotid gland and anterior part receives condyle of mandible.

7 **What nerve and artery pass through the foramen ovale of the sphenoid bone?**

Mandibular division of 5th cranial; small meningeal branch of internal maxillary artery.



1 **Mention the muscles attached to the inferior maxillary bone.**

Fifteen pairs: levator menti, depressor labii inferioris, depressor anguli oris, platysma myoides, buccinator, masseter, orbicularis oris, genio-hyoglossus, genio-hyoid, mylo-hyoid, digastric, superior constrictor, temporal, internal and external pterygoids.

2 **Mention the principal veins of the head and neck.**

Frontal, angular, facial, internal maxillary, temporo-maxillary, ophthalmic; superior longitudinal, inferior longitudinal, straight, lateral, occipital, superior and inferior petrosal, transverse, circular and cavernous sinuses; external, anterior and internal jugular vertebral veins.

3 **What muscles are attached to the basilar process of the occipital bone?**

Rectus capitis anticus major and minor, and superior constrictor of pharynx.

4 **Give the boundary of the anterior triangle of the neck.**

Is bounded anteriorly by line extending from chin to sternum; behind by anterior margin of sterno-mastoid muscle; above by lower border of body of mandible and line extended posteriorly to mastoid process.

5 **Mention the muscles attached to the outer surface of the malar bone.**

Levator labii superioris, zygomaticus major and minor.

6 **Describe the sigmoid notch.**

Situated between condyle and coronoid process of mandible; transmits masseteric vessels and nerves.

7 **Mention the branches of the maxillary portion of the internal maxillary artery.**

Tympanic, middle meningeal, small meningeal and inferior dental.

- 1 **Mention the branches of the posterior auricular artery.**  
Stylo-mastoid, auricular, mastoid.

- 2 **Give the branches of the internal maxillary artery.**

From the maxillary portion: tympanic, *middle meningeal*, small meningeal, *inferior dental*. From the pterygoid portion: deep *temporal*, buccal, *pterygoid*, *masseteric*. From the spheno-maxillary portion: alveolar, *infra-orbital*, *descending palatine*, vidian, *pterygo-palatine*, *spheno-palatine*.

- 3 **Describe the Gasserian ganglion.**

Is developed upon the sensory root of the 5th cranial nerve, and is located in a depression on the petrous bone near its apex, cranial surface. From its anterior margin 3 divisions, the ophthalmic, maxillary and mandibular pass through the sphenoidal fissure, the foramen rotundum and the foramen ovale, respectively. The motor root of this nerve rests upon the petrous bone beneath the sensory root, uniting with the mandibular division after it has passed through the foramen ovale.

- 4 **Give the origin and insertion of the sterno-thyroid muscle.**

From the manubrium sterni and the cartilage of the 1st rib, into the oblique ridge of the thyroid cartilage.

- 5 **Describe the mylo-hyoid muscle, giving its origin and insertion.**

It forms, with the opposite mylo-hyoid, the floor of the mouth. Origin, is from the mylo-hyoid ridge of the mandible; insertion, into the body of the hyoid bone, meeting its fellow in a median raphé.

Nerve, mylo-hyoid, a branch of inferior dental; action, to carry tongue upward and forward.

- 6 **Mention the orbital branches of the ophthalmic artery.**

Lachrymal, muscular, anterior and posterior ethmoidal, supra-orbital, frontal and nasal.

**Describe the temporal fossa.**

Is bounded above by temporal ridge, below by pterygoid ridge on great wing of sphenoid and extends from external angular process of frontal to a point above mastoid bone. It is formed by parts of five bones: sphenoid, frontal, temporal, parietal and malar. It gives origin to the temporal muscle.

**Describe the great wing of the sphenoid bone.**

A large, strong process, extending from the side of the body of the sphenoid outward, forward, upward and backward, and continued behind into a sharp, pointed extremity, its spinous process, which contains the foramen spinosum, transmitting the middle meningeal artery. Its upper surface is concave for the temporal lobe of the cerebrum; its external surface forms part of temporal and of zygomatic fossae, which are separated by the pterygoid ridge. The greater wing presents 2 important foramina, viz., foramen ovale and foramen rotundum; it forms the lower margin of the sphenoidal fissure and the upper boundary of the sphenomaxillary fissure.

**Give the course and distribution of the arteries and nerves which supply the upper alveolar arch.**

Arterial supply is derived from alveolar or posterior dental branch of internal maxillary, which sends branches into posterior dental canals to supply molar and bicuspid teeth and lining of antrum; also from anterior dental branches of infra-orbital, which descend through anterior dental canals in wall of maxilla to be distributed to incisor and canine teeth.

Nerve supply comes from posterior superior dental branches of superior maxillary division of the 5th cranial, which enter posterior dental canals, to be distributed to posterior teeth and to communicate with middle superior dental branch of superior maxillary nerve which passes down through special canal in outer wall of antrum, and with anterior superior dental nerve, another branch of superior maxillary nerve which enters a canal in anterior wall of antrum, these branches supplying the teeth in their respective regions.

**Describe the lesser wings of the sphenoid bone.**

They rise from the anterior superior surface of the sphenoidal body to which they are attached by 2 roots enclosing the optic foramen, which transmits the optic nerve and ophthalmic artery. The superior surface is smooth and flat, broad internally and tapering to a point externally, and supports part of the frontal lobe of the brain. The under surface forms the upper boundary of the sphenoidal fissure, and the posterior border is received by the fissure of Sylvius.

**Describe the palatine surface of the superior maxillary bone.**

Is formed by the palate process which projects horizontally inward to articulate with palate process of the opposite bone, and with palate bone posteriorly. Its inferior surface is slightly concave and rough for muco-periosteal covering of roof of mouth. When both superior maxillary bones are articulated, a large orifice, the anterior palatine canal, is formed just behind the incisor teeth in the median line. On the under surface of the palate process may sometimes be seen the intermaxillary suture, extending from the anterior palatine foramen to between the lateral incisor and canine tooth. This indicates the line of union between the maxilla and the intermaxillary, (premaxillary, or incisive) bone.

**Describe the submaxillary triangle.**

Is bounded, above, by lower border of body of mandible and a line drawn from its angle to the mastoid process; below by the posterior belly of the digastric; in front by the median line. Its floor is formed by mylo-hyoid and hyoglossus muscles. It contains the submaxillary gland, facial artery and vein, submental artery and mylo-hyoid artery and nerve; more posteriorly is the external carotid artery; more deeply are the internal carotid artery, internal jugular vein and the pneumogastric nerve.

**Describe the middle cerebral artery.**

It is a branch of the internal carotid, given off at the an-

terior perforated space, and courses outward, upward and backward in the fissure of Sylvius. Its branches are: Antero-lateral ganglionic, (including the lenticulo-striate) inferior external frontal, ascending frontal, ascending parietal, parieto-temporal.

**Mention the facial branches of the facial artery.**

Muscular, inferior labial, superior and inferior coronary, lateral nasal and angular.

**Describe the lateral sinuses.**

Right and left lateral sinuses commence at internal occipital protuberance, right being formed by superior longitudinal sinus, left by straight sinus; are located in attached margin of tentorium and groove of occipital, of parietal, of mastoid and then of occipital bone, again leaving cranial cavity through jugular foramen, just outside of which they unite with inferior petrosal sinus to form internal jugular vein.

**Mention the muscles attached to the superior maxillary bone.**

Twelve: orbicularis palpebrarum, levator labii superioris alaeque nasi, inferior oblique, levator labii superioris, levator anguli oris, compressor naris, depressor alae nasi, dilatator naris posterior, orbicularis oris, buccinator, masseter and internal pterygoid.

**Describe the supra-orbital artery.**

Is a branch of ophthalmic artery, passes forward between levator palpebrae and periosteum of orbital roof to supra-orbital foramen, where it appears on external surface of frontal bone and divides into superficial and deep branches supplying integument, muscles and epicranial aponeurosis, anastomosing with temporal, frontal and opposite supra-orbital.

**Mention the vessels and nerves that supply the sub-maxillary gland.**

Facial artery, facial vein; nerves from submaxillary



ganglion, which is formed by branches from chorda tympani, lingual and from sympathetic plexus around facial artery.

**Describe the Island of Reil.**

Also called central lobe, is deeply placed in Sylvian fissure, is of pyramidal shape and consists of 6 or 7 convolutions.

**State the formation and course of the inferior vena cava.**

Is formed on right side of 5th lumbar vertebra by union of the 2 common iliac veins. It rests upon bodies of lumbar vertebrae, lying to right of aorta, grooves posterior surface of liver, and passes through caval opening in diaphragm to terminate in right auricle.

**State the origin, exit, distribution and functions of the pneumogastric nerve.**

Superficial origin from side of medulla in groove between olivary and restiform bodies; exit through jugular foramen; distributed to posterior part of auricle and external auditory meatus, motor nerve to pharynx, sensory and motor to larynx, helps to form superficial (left nerve) and deep cardiac plexuses, furnishes pulmonary, oesophageal and gastric branches.

**Describe the cavernous sinus.**

So named from being traversed by interlacing filaments. Is placed on side of body of sphenoid bone and extends from sphenoidal fissure to apex of petrous bone. It receives ophthalmic vein anteriorly, terminates in petrosal sinuses posteriorly, and communicates with opposite cavernous sinus through circular sinus. The following structures pass through it: 3d, 4th and ophthalmic division of 5th nerves, 6th nerve and internal carotid artery.

**Describe the thyroid gland.**

It consists of right and left lobes connected by an isthmus across 2d, 3d and 4th tracheal rings; has a capsule and trabeculae surrounding closed follicles, which contain colloid ma-

terial. Arterial supply comes from superior and inferior thyroid arteries; thyroid veins drain it. It is intimately attached to trachea and alae of thyroid cartilage, and rises and falls with larynx.

**Bound the occipital triangle.**

In front, by sterno-mastoid muscle; behind, by trapezius; below, by posterior belly of omo-hyoid; apex of triangle is at occiput.

**Describe the outer surface of the occipital bone.**

Is convex, smooth above, rough below. Superior curved line extends transversely, with external occipital protuberance at center; from latter, external occipital crest passes downward to posterior margin of foramen magnum, and meets inferior curved line half way down. Antero-lateral margins of foramen magnum are bounded on either side by occipital condyles, in front of which is anterior condyloid foramen, and behind which is posterior condyloid foramen. Under surface of basilar process is rough for muscles, and presents pharyngeal spine at its center. Margins are roughly serrated, jugular processes extend laterally.

**From how many centers of ossification is the temporal bone developed?**

Ten.

**What is an aponeurosis?**

It is a more or less broad, flat sheet of fibrous tissue to which muscular fibers are attached, serving as a tendon of insertion for these fibers.

**Describe the horizontal plate of the palate bone.**

Is quadrilateral and presents two surfaces and four borders. Superior surface is smooth and slightly concave from side to side, forming posterior floor of nose; inferior surface is rough, forms posterior part of roof of mouth, and at outer posterior angle is deeply grooved to help form posterior

palatine canal. Anterior border is serrated to articulate with palate process of superior maxillary bone; posterior border is smooth, concave, and gives attachment to soft palate; internal border is thick and serrated for articulation with opposite horizontal plate; external border joins perpendicular part of palate bone.

### **What are the bones of Bertin?**

The sphenoidal turbinals, two in number, hollow, pyramidal, attached to anterior surface of body of sphenoid, near rostrum; they form the roof of each nasal cavity and a small part of the inner wall of the spheno-maxillary fossa.

### **Define veins, arteries, lymphatics.**

Veins are tubular parts of the blood-vascular system carrying venous blood from all parts of the body toward the right auricle, or arterial blood from the lungs toward the left auricle; their walls are thin and their tunica intima forms reduplications, or valves, in some veins.

Arteries are vessels carrying blood away from the heart,—arterial in all cases except in the pulmonary artery, where the blood is venous, en route to the lungs; the wall of the artery is relatively thick.

Lymphatics are vessels which convey lymph from all parts of body to venous circulation at base of neck, on each side; lymphatics of mesentery are called lacteals.

### **Describe the ophthalmic vein.**

There are 2 ophthalmic veins, superior and inferior. Superior ophthalmic vein connects angular vein at inner angle of orbit with cavernous sinus; it takes the same course as the ophthalmic artery, receiving tributaries from upper orbital contents. The inferior ophthalmic vein drains the floor of the orbit, passing through spheno-maxillary fissure to end in pterygoid plexus of veins, or through sphenoidal fissure to terminate in cavernous sinus.

1 **Mention the branches of the inferior thyroid artery.**

Inferior laryngeal, tracheal, esophageal, ascending cervical, muscular.

2 **Give the articulations of the ethmoid bone.**

With 15: sphenoid, 2 sphenoidal turbinated, frontal, 2 superior maxillary, 2 lachrymal, 2 nasal, 2 palate, 2 inferior turbinated, and vomer.

3 **Describe the medulla oblongata.**

Is a part of encephalon, continuous with spinal cord below and with pons above; it rests upon the basilar process of occipital bone, consists of white nerve matter externally and gray matter arranged irregularly, internally, the latter appearing upon the surface in floor of 4th ventricle, the lower half of which is formed by medulla; upon ventral surface is anterior median fissure, partially obliterated below by decussation of crossed pyramidal tracts; near anterior part of inferior surface are olivary bodies; posterior columns diverge to form calamus scriptorius and to bound 4th ventricle laterally for its lower half; postero-laterally are restiform bodies which can be traced upward into cerebellum, forming inferior peduncles of latter. Cranial nerves from 7th to 11th inclusive arise from side of medulla, while 12th appears upon surface in groove between olivary body and anterior pyramid.

4 **Give the articulations of the lachrymal bones.**

With 4 bones: frontal, ethmoid, superior maxillary and inferior turbinated.

5— **Mention the muscles and ligaments attached to the ramus of the jaw.**

Masseter, temporal, external and internal pterygoids; ligaments are capsular (external lateral), internal lateral (spheno-mandibular), and stylo-mandibular.

**Mention the vessels and nerves supplying the parotid gland.**

Arteries are derived from external carotid; veins, tributaries to external jugular; lymphatics terminate in superficial and deep cervical nodes; nerves are derived from facial, auriculo-temporal, great auricular, and sympathetic plexus on external carotid artery.

**Describe the 9th (glosso-pharyngeal) nerve.**

Arises from groove between olivary and restiform bodies, passes out of cranial cavity through jugular foramen, divides into lingual and pharyngeal branches, supplying mucous membrane of posterior part of tongue (circumvallate papillae) and mucous membrane of pharynx. A branch (Jacobson's) is distributed to tympanum.

**Describe briefly the 5th nerve.**

Superficial origin of both motor and sensory roots is from pons near anterior margin; Gasserian ganglion develops on sensory root and rests on apex of petrous bone, now forming 3 divisions, ophthalmic, maxillary and mandibular; ophthalmic division divides into frontal, nasal and lachrymal branches which leave cranial cavity by sphenoidal fissure; maxillary division leaves cranial cavity by foramen rotundum, crosses sphenomaxillary fossa, enters orbit, terminating as infra-orbital nerve; mandibular division and motor root leave cranial cavity by foramen ovale, unite and then divide to supply muscles of mastication with motor influence, and anterior part of auricle, lower jaw and part of tongue with sensory influence.

**Give a general description of the alimentary canal, naming its successive divisions.**

Its parts, in order, are: mouth, pharynx, esophagus, stomach, duodenum, jejunum, ileum, and large intestine (caecum, ascending, transverse, descending and sigmoid colons, rectum, and anal canal).



Mouth is composed of upper and lower jaws covered by cheek walls, with buccal orifice directed transversely; contains tongue, at base of which are fauces with anterior and posterior pillars and tonsils.

Pharynx joins esophagus at lower border of cricoid cartilage; esophagus is 10 inches long and passes through diaphragm to be continued into stomach.

Stomach occupies epigastric and left hypochondriac regions and presents a cardiac and a pyloric extremity and a greater and a lesser curvature. Its wall consists of 4 coats, viz., serous, muscular, areolar and mucous.

Duodenum is fixed and curved around head of pancreas; common bile and pancreatic ducts open into it; jejunum, attached to posterior abdominal wall by mesentery, extends for 20 feet, or more, to ileo-caecal junction, where it joins large intestine; vermiform appendix is attached to caecum (usually inner side), below ileo-caecal valve; ascending colon passes to liver, forms hepatic flexure; transverse colon, with great omentum attached, crosses to spleen and forms splenic flexure; descending colon reaches left iliac fossa and is continued into sigmoid which curves around into pelvis, resting on sacrum; rectum curves forward and anal canal, guarded by internal (involuntary) and external (voluntary) sphincters, opens downward and slightly backward.

**Give the origin, course and distribution of the great sciatic nerve.**

Origin from lower lumbar and upper sacral nerves (sacral plexus); course, through great sacro-sciatic foramen below pyriformis muscle, from beneath lower margin of gluteus maximus midway between trochanter major and tuber ischii, rests upon adductor magnus and divides about middle of thigh into internal and external popliteal nerves; it supplies semitendinosus, semimembranosus, adductor magnus and biceps. Internal popliteal is continued down leg as posterior tibial, distributed to back of leg and sole of foot; external

popliteal curves around below head of fibula to front of leg, becoming anterior tibial to front of leg and dorsum of foot.

**Describe the anatomical position of the thoracic duct.**

**(b) Where does it terminate? (c) What does it convey?**

Thoracic duct begins in receptaculum chyli on body of 2d lumbar vertebra, to right of aorta, passes through aortic opening of diaphragm into posterior mediastinum. (b) It terminates at junction of left internal jugular and left subclavian veins. (c) It conveys lymph and chyle.

**Give the origin, insertion and nerve supply of the styloglossus muscle.**

Origin, from styloid process of temporal bone; insertion into side of tongue; nerve, hypoglossal.

**Bound the superior carotid triangle.**

Behind, by sterno-mastoid; below, by anterior belly of omohyoid; above, by posterior belly of digastric.

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